Preface

The 1951 Research Report, a supplement to the Proceedures of the North Central Weed Control Conference, is submitted herewith. The publication is prepared in advance and represents the combined efforts of a large number of workers and the 26 members of the Research Committee. There are 8 different projects (1) control of perennial weeds, (2) control of annual winter annual and biennial weeds, (3) control of weeds in field crops, (4) control of weeds in vegetable crops, potatoes, sugarbeets, small fruits and ornamentals, (5) new herbicides (6) control of woody plants, (7) mechanical considerations (8) basic problems. Projects 1, 3 and 4 have had to be split up into several divisions.

The information found in this report is derived from the experimental work done or completed this year and will be available for us this next year. In certain cases, the results will be much the same as has been submitted the last two years. When a worker finds this situation true, he gains confidence in his results and in many cases can give his recommendations earlier than otherwise. Methods and chemicals for the control of Johnson Grass in Ohio will be of material assistance in developing a program for controlling quackgrass in Minnesota. It might seem as if the control of annual weeds in economic crops was well established, New problems are continually presenting themselves - new varieties, new chemicals. There is associated with these the ever variable environmental factors. Not so long ago the dinitro compounds were generally recommended for controlling annuals in flax. It was found that a weak solution of 2,4-D will do the job as effectively or possibly better. Perhaps the methoxane of England may still be better. It has been found that flax is tolerant of sodium trichloracetate which makes itself important as there is a possibility of controlling annual weeds like foxtail and barnyard grass. The control of weeds in vegetable crops has made strides particularly through pre-ermergence practices destroying the weeds as they start. New herbicides are being developed each year. Woody plants or brush covers thousands acres of farm land and here chemicals are paving the way for a cheap and effective way of controlling these plants. Mechanical equipment has made extensive improvements from the time of the walking plow but greater demands are put to agricultural engineers in this chemical age. Good mechanical practices will always be required.

Throughout there has been an attempt to determine the basic causes for the action of the control measure whether it be herbicidal or mechanical in nature. When it is remembered that the plant is a living organism and in a continual status of change, it is difficult to answer the questions appearing except as to the result produced. With continued study our knowledge is bound to increase. When it is remembered that this is only the eighth meeting of the North Central Weed Control Conference, and that the first report of the action of 2,4-D came out in 1945, the subject of weed control has made a remarkable advance.

This report would not have been possible without the close cooperation of the 150 contributors. The Chairman wishes to thank each and every one who has assisted in making this 1951 Report. - A. L. Bakke, Chairman, Research Committee

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Oak black jack	-	Quercus marylandica	148,149,151,152 153,154,157
Oak bur	-	Quercus macrocarpa	161,163, 156
Oak live	-	Quercus virginiana	149
Oak pin	-	Quercus palustris	156
Oak post	-	Quercus stellata	148,149,151,152,153,154,157
Oak scrub	-	Quercus ellipsoidales	163
Oak shinnery	-	Quercus havardi	149
Oak white	-	Quercus alba	159
Oak shingle	-	Quercus imbricaria	156
Osage orange	-	Maclura pomifera	149
Persimmon	-	Drospyros virginiana	154,158,150
Pine jack	-	Pinus banksiana	156,163
Pine red	-	Pinus resinosa	156
Plum, wild	-	Prunus spp.	163
Poplar	-	Populus tremuloides	148,159
Raspberry	-	Rubus strigosus	105,106,107,139
Rose	-	Rosa spp.	141,146,148,159,160,161,163
Sassafras	-	Sassafras albidum	158
Silver berry	-	Elaegnus argentea	160
White brush	-	Aloysia ligustrina	157
Willow	-	Salis spp.	148,159,160,163

Project I. Control of Perennial Herbaceous Weeds

Canada and Perennial Sow Thistle

F. W. Slife

Summary

From the reports submitted for the past several years, it is clear that Canada thistle and perennial sow thistle cannot be eradicated with one treatment of the 2,4-D compounds. This also seems to be true for the 2,4,5-T and MCP compounds. The most effective date of treatment seems to be in the bud stage or early bloom stage. A few reports submitted in 1950 and 1951 indicate that 2,4-D may be more effective in eradication if combined with cultivation or close mowing. In 1951 three investigators reported the use of repeated light rates of 2,4-D on Canada thistle. Two of the three trials indicated no difference in regrowth between repeated light rates and one heavy rate. One report, however, showed that the repeated light rates did move farther into the root system than one application. No definite conclusions can be drawn from these trials since each investigator used different light rates with different chemicals applied at different intervals.

CMU gave good results in 1951 on Canada and perennial sow thistle when applied between 20 and 40 pounds per acre. These reports indicate that rates lower than 40 pounds per acre may eradicate these two weeds but more trials are needed.

Chemicals such as 2,4-D, 2,4,5-T, and MCP are useful in controlling seed production and growth of Canada and perennial sow thistle but eradication is difficult requiring repeated treatments over a period of several years. Length of time required for eradication seems to vary from patch to patch and may be due to the thistles themselves or the soil and climatic conditions.

Abstracts of Results of Cooperators

Effect of CMU (3-(p-chlorophenyl)-1,1-dimethyl urea) on Canada thistle (Cirsium arvense). Burt, E. D., Hill, G. D., and Willard, C. J. CMU (80% technical material) was applied to Canada thistle at 0, 20, 40 and 80 lb./A., at four stages of growth - rosette (April 20, 1951), bud (May 29), rosette, after mowing (July 6), and 10 inches of fall growth (September 5). All treatments were applied in 40 gallons solution per acre, no dispersing agent. All rates gave complete control of all vegetation except thistle at each stage of growth. The 20-pound rate gave 85 to 90 percent top kill, the 40 and 80 pound rates 100 percent top kill at all stages. Regrowth of thistle occurred during dry periods in all plots treated on April 20 and May 29. Twice, this regrowth died after approximately 0.05 inches of rain. No regrowth to November 1 on plots treated July 6 and September 5. July and August were the driest in the history of the Columbus Weather Bureau. Ohio Agricultural Experiment Station.

Effect of repeated herbicidal applications on the control of Canada thistle. Bakke, A. L. and D. W. Staniforth. Repeated applications of 2,4-D were given the Canada thistle plants growing in corn at the early bud stage. Eight applications of the ester formulation 1/4 lb. per acre at 2-day intervals, 4 applications at 1/2 lb. at 2-day intervals and 4 applications of 1/2 lb. at 4-day intervals, 2 applications at one-day interval at the one lb. rate killed the thistles. Four applications at 4-day intervals of the amine salt also killed the thistles.

A single application of MCP ester formulation at the rate of 2 lb. per acre appeared to be as effective as 8 applications of the 1/4 lb. of 2,4-D.

CMU applied at the rate of 40 lb. per acre killed both corn and thistles. Where 10 lb. were used there was some regeneration. Motherwort (Leonurus Cardiaca) resistant to 2,4-D was killed with CMU. Contribution of the Iowa Agricultural Experiment Station.

Effect of 2,4-D on perennial sow thistle (Sonchus arvensis). Friesen, H. A. and Keys, C. H. The alkanolamine amine of 2,4-D was sprayed at 3/8 lb. of acid equivalent per acre on Sonchus in Thatcher wheat. The Sonchus was 8 inches tall and the wheat 10 inches tall at the time the spraying was done. 85 percent kill of the top growth of Sonchus resulted from this treatment with no apparent adverse effect on the crop. The remaining Sonchus plants were severely stunted and deformed and produced little if any viable seed.

The alkanolamine amine and the isopropyl ester were sprayed on a mixed weed population consisting of 85% Sonchus arvensis and 2 percent Cirsium arvense on land being summerfallowed. Each formulation was applied at dosages of 3/4, 1, 2 and 3 lb. of acid equivalent per acre when the Sonchus and Cirsium were in the early bud stage, on July 9. On August 28, the 3/4 pound rate of each formulation had killed 90 percent of the top growth while the remaining treatments had killed 100 percent of the top growth. The plots were one-way disced at a depth of 4 inches on August 28. Although no subsequent tillage was given, there was no sign of growth on the treated plots on October 5. Moisture conditions were very good throughout the season. Contributed by the Dominion Experimental Station, Scott, Sask.

Effect of various herbicides and adjuvants on Canada thistle. Hill, Gideon D., and Willard, C. J. Canada thistle plots were treated in May, 1951, when thistles were 10"-14" high, and in August, 1951, when the regrowth on these plots reached a height of 5"-6", as follows: (All rates in acid equivalent per acre.) Triethanol amine salt of 2,4-D at rates of 1/4, 1/4 + 1% sucrose, 1/4 + 0.5% Tween 20, 1/2, 1/2 + 1% sucrose, 1/2 + Tween 20, 1/8 every 4 days, 4 times, 1/8 + 1% sucrose every 4 days, 4 times, 1/8 + 0.5% Tween 20 every 4 days, 4 times, 1/16 every 2 days, 8 times, 1/2 + 60 ppm vitamin K, 1 1/2, 1 1/2 + top injury first, 1 1/2 + 0.5% Tween 20, 1 1/2 + 60 ppm vitamin K, 5, 10, and 20; amine salt of MCP at rates of 1/4, 1/4 + 1% sucrose, 1/4 + 0.5% Tween 20, 1/2 + 1% sucrose, 1/2 + 0.5% Tween 20, 1/8 every 4 days, 4 times, isopropyl ester of 2,4-D at rates of 1/2, 1/8 every 4 days, 4 times, 1 1/2, 1 1/2 + 60 ppm vitamin K; polypropylene ester at rates of 1 1/2, 1 1/2 + 60 ppm vitamin K; 2,4,5-T at rates of 1/2 and 1 1/2; 2,4-D acid as wettable powder in non-toxic oil at 1/2 and in Diesel oil at 1. No definite conclusions on kill can be drawn until the spring of 1952. All ester formulations at 1/2 pound and above and the amine salt at 1 1/2, 5, 10, and 20 pounds gave rapid top kill. Excavations showed that regrowth from plants treated with 5, 10, and 20 pounds started at 2 inches below ground level while 1/16 pound amine for 8 treatments killed the stems to a depth of 7 inches and the plants showed a lower percentage reinfestation than the higher rates. TCA (90% sodium salt) applied at 50, 100, and 200 pounds per acre in May, 1951, caused no visible effect on the thistle. Sodium chlorate applied at 500 pounds per acre gave excellent control of thistle. Ohio Agricultural Experiment Station.

The effect of C.M.U. on perennial sow thistle. Knowles, Geo. C.M.U. was applied as a post emergence treatment at the rates of 20, 40 and 80 pounds per acre on perennial sow thistle (Sonchus arvensis). This weed was completely controlled by all three rates. It should be pointed out that the above treatments were applied on sow thistle growing in a nursery plot. Central Experimental Farm, Ottawa, Ontario.

A field study to evaluate herbicides for the control of Canada thistle (Cirsium arvense). Miller, J. H., Heggeness, H. G., Dunham, R. S. 22 herbicides were applied

at rates of 1.5 to 8 pounds of acid equivalent in 40 gallons of water per acre on a moderately well-drained soil very heavily infested with Canada thistle. Nine of the herbicides were applied in the spring of 1950 and again in the spring of 1951 on the same plots. Results between replicated plots with many of the herbicides were extremely variable.

While none of the herbicides killed all of the Canada thistle, nearly all caused some reduction in stand. Of the nine applied both years, butoxyethanol ester of 2,4-D (ACP 683) and butoxyethanol esters of 2,4-D and 2,4,5-T (Weedone 32) killed most consistently. Also an amine and ester of MCP, emulsified acids of 2,4-D and 2,4,5-T (ACP 926) and a dimethylamine salt of 2,4-D showed promise. Six chemicals were applied only in the spring of 1951 at rates of 2 and 8 pounds of acid in 40 gallons of water per acre. Of these, on the basis of fall observations, the MCP amine formulations appear to have promise at both rates and an amine of 2,4-D (ACP-L-127) at the 8 pound rate. Because of the extreme variability encountered in this work, additional laboratory studies are being made in an attempt to determine whether these variations are due to soil, topography, or other factors. Joint contribution of the Division of Weed Investigations, BPIS and AE, USDA, Minnesota Agricultural Experiment Station, and Minnesota State Department of Agriculture.

Effect of systemic herbicides on perennial sow thistle, 1951. Pavlychenko, T. K. On August 2, square rod plots of perennial sow thistle (Sonchus arvensis) in a low-lying area of abandoned land, were treated with 2,4-D esters (Weedone Concentrate 48 Weedone LV4 and ACP649); 2,4-D amines (Weedar 64,ACP127); amine of MCP (Weedar) and a mixture of 2,4-D and 2,4,5-T (Weedone Brush Killer 32) at 2 and 4 lb. per acre, in 70 gallons of water per acre. The stand was very uniform and dense, ranging from 200 to 225 plants per square yard. At the time of treatment about 90 percent of the population was in the late rosette stage, the remaining 10 percent was in the early flowering stage. RESULTS: On September 12 preliminary records were taken from these plots. The top growth was in a process of gradual deterioration, which obviously was not completed at that time. The best treatments produced from 85 to 100 percent topkill with no regrowth. These treatments also produced proliferated tissues on the roots, giving them a knobby appearance, accompanied by decomposition of the root tissues. Weedone Concentrate 48, reduced to 10 percent acid equivalent and ACP649 at both rates and Weedone LV4 and ACP127 at 4 lb. per acre were particularly effective. The remaining treatments gave top-kills ranging from 10 percent with Weedar MCP to 75 percent with B.K.32. These same treatments produced a lesser degree of damage to the roots, ranging from slight to moderate amounts of proliferation of root tissues. There were very few buds found on any of the roots excavated, both in the treated plots and in the checks. Final results on regrowth will be taken in 1952. Contributed by Agricultural Division, American Chemical Paint Co., Saskatoon, Sask.

Results of 2,4-D sprays on Canada thistles. Slife, F. W. Canada thistles were sprayed in the bud stage on June 14, 1950, with an isopropyl ester of 2,4-D and ACP 648, a low volatile ester of 2,4-D. Rates used were 1/16, 1/8, 1/4, 1/2, and 2 lb. of acid per acre. The 1/16 pound rate plots of both chemicals were treated every 10 days until a total of five treatments had been made. All other plots were treated on August 15. Stand counts of thistle plants taken during the spring of 1951 on these plots indicated there were less thistle shoots on the 2 pound plots than on any others. There was little difference in stand between 1/16, 1/8, 1/4, and 1/2 pound plots. It was evident that the ACP 648 was not as effective against the thistles as the isopropyl ester of 2,4-D. This was also true of the other weeds in the plots. Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.

Project I. Control of Perennial Herbaceous Weeds

Quack Grass

D. E. Kratochvil

Summary

Twenty two abstracts were reported on investigations in the control of quack grass. The majority of the abstracts reported work on TCA and TCA-cultivation investigations. Several reports on CMU were received. Other chemicals reported on were Endothal, 2,4-D, Borascu, Polybor-chlorate, and Sodium chlorate. In general the results were as follows:

1. Fall applications of TCA gave better results than spring applications. From early August on appears best.

2. Cultivation in conjunction with TCA treatments increased the results of spring applications more than did cultivation with fall applications.

3. Plowing or one-way discing gave better results than spring-tooth harrowing or such means.

4. Cultivation prior to chemical treatment gives greater elimination than cultivation after treatment.

5. Rates of TCA required for effective control may vary in different areas. In general 40 - 80 pounds of acid per acre are needed.

6. Calcium TCA and sodium TCA were reported as being about equal in effectiveness for quack grass control. TCA acid in oil gave better results at 25 pounds per acre than comparable rates of the calcium and sodium salts, but they did not show this at the 50 pound rate.

7. One abstract reported no residual affect on corn or soybeans the year after the chemical was applied. Alfalfa completely recovered after spring treatments of 10, 20, 40, or 80 pounds per acre for control of quack grass.

8. Follow up methods of chemical or cultural treatment are usually required to prevent reinfestation.

9. CMU is a very slow action chemical. All reporters except one indicate complete control with 80 pounds per acre or more. Twenty five to eighty pounds gave effective control.

10. CMU is indicated as having a long residual action in soils.

11. Sodium chlorate at 3, 6, or 9 pounds per 100 square feet gave complete control.

12. Endothal 2,4-D, Borascu, and Polybor-chlorate were effective at rates used.

Abstracts of Results of Cooperators

Effectiveness of cultural and TCA treatments on quack grass. Buchholtz, K. P. Plots 20 feet by 20 feet were established in an old quack grass sod on Miami silt

loam soil. Plots were sprayed on August 1, 1950 with 0, 10, 20, 40, and 80 pounds of Tca per acre using water equivalent to 80 gals. per acre. Cultural treatments used were no cultivation, 1 cultivation with a springtooth field cultivator on Nov. 9, and cultivations on Sept. 7 and Nov. 9. A two way design was used with 4 replications. In May, 1951, the area was plowed and planted to corn and soybeans. On July 25, quack grass shoot counts were made on uncultivated areas in each plot. The cultural treatments gave the most significant responses. Shoot counts on plots given no treatment, 1 cultivation, and 2 cultivations with TCA applications averaged 24.0, 11.1, and 1.9 shoots per square foot respectively. No rates of TCA application improved significantly the control obtained with two cultivations. Use of TCA improved control of quack grass obtained when combined with 1 cultivation, but there was no advantage to use of more than 20 lbs. per acre. Use of 40 lbs. or more ofTCA alone gave control that was better than that following 1 cultivation. Crops grown on the various plots appeared to be unaffected throughout the season by residual TCA in the soil. Considerable reduction in crop growth was noted during the latter part of the season on plots having the heavier quack grass infestations. Department of Agronomy, University of Wisconsin, Madison, Wisconsin.

Rhizome weights of quackgrass following treatment with TCA. Buchholtz, K. P. One square rod plots. in an old, uniformly infested quack grass sod were treated with 0, 20, and 80 pounds per acre applications of TCA as the sodium salt on May 3, 1950. Applications were made with water equivalent to 40 gallons per acre and 4 replications were used. Soil type of the area was Miami silt loam. The quackgrass rhizome supply was followed by sampling the plots at monthly intervals from April thru October of 1950 and again in April of 1951. Five 5 inch plugs were taken at random in each plot, the living rhizomes sorted and dry weights obtained. Plots initially had from 20.1 to 24.1 gms. of rhizome tissue per sq. ft. By July the weights of rhizomes in check plots had risen to 34.6 gms. and were maintained at this level during the balance of the study. Rhizome weights from plots treated with 20 lbs. of TCA changed only slightly from original weights and reached a low of 17.6 gms. in September after which they rose slightly. Plots treated with the 80lb. application declined gradually until October when they contained 5.1 gms. of rhizomes per sq. ft. By April, 1951, the rhizome weights of these plots had risen to 8.6 gms. Reinfestation occurred rapidly on all plots during the balance of the 1951 season. It appears that the elimination of top growth for several months produced by low rates of TCA application have limited usefulness in reducing viable quackgrass rhizome tissue. Higher rates of application reduce rhizome weights slowly. Enough tissue usually survives the period of TCA toxicity in the soil so that the area may be reinfested if supplementary cultural or chemical treatments are not used. Department of Agronomy, University of Wisconsin, Madison, Wisconsin.

Response of couchgrass to CMU. Carder, A. C. A continuous sward of couch, Agropyron repens, was sprayed with CMU at 20, 40, 80, and 100 pounds active ingredient per acre in the spring when it possessed 3-4 inches of growth. About four days after application the couch turned a very dark green to black as though severly burned by the chemical. However, about two weeks later or in early June, all treatments showed marked recovery in that vigorous new growth had been produced. By mid-July this new growth showed severe necrosis and this effect progressed until mid-August when it would seem that with the heavier rates complete killing had occurred. Nonetheless, by early September a weak new growth appeared in all plots and this remained until freeze-up. (Contributed by Dominion Experimental Station, Beaverlodge, Alberta).

Treatment of Couchgrass with TCA alone and in combination with cultural means. Carder, A. C. A sward of couch, Agropyron repens, on a deep sandy, black loam was treated in 1950 with sodium TCA at nil, 25, 50, 75, and 100 pounds acetate equivalent per acre. Treatments were made in the spring when the couch possessed 4 to 5 inches of leaf growth and on an adjacent area in the fall about a month prior to cessation of growth by onset of winter. The chemical was applied (1) on undisturbed sod, (2) following one-waying 5 inches deep, (3) following double one-waying 5 inches deep and (4) following one-waying 5 inches ddep, but preceding a second one-waying. Cultivation and herbicidal treatments were made the same day. Soil moisture was good at time of the spring treatments, but no substantial rainfall occurred for almost 2 months thereafter. Moderate moisture obtained when the fall treatments were made and fair rains occurred about 3 weeks later.

Killing of couch was assessed when maximum effect of the treatments had occurred. Outstanding were the autumn treatments which, in every instance, proved more lethal than those of the previous spring. In the case of the former, the effectiveness of the chemical was not increased by tillage except where a very low rate was employed, i.e., 25 pounds. Kills on undisturbed sod were: 55, 97, 99, and 100 per cent for the 25, 50, 75, and 100 pound rates, respectively. No one tillage method proved better than any other. In the case of the spring treatments the potency of the chemical was markedly enhanced by tillage. Here again no one method of cultivation proved superior.

Residual effect of the chemical was studied by preparing a seed-bed and planting rows of Saunders wheat, Redwing flax, and Chancellor peas where the 50 and 100 pound rates had been applied the previous autumn. With the lighter dosage the wheat completely killed out, the oats almost so, the flax did poorly, while the peas were little affected. With the heavier rate the wheat and oats succumbed, the flax nearly so and the peas showed definite reduction of vigor. Unfortunately, the residual effect of the chemical where applied in the spring or a full year previous was not assessed. (Contribution of Dominion Experiment Station, Beaverlodge, Alberta).

Effects of Sodium TCA and Calcium TCA on couch grass in cultivated soil. Corns, W. G. Plots heavily infested with couch grass were sprayed with Sodium TCA or Calcium TCA following cultivation with a one-way disc on June 14, (stage 1) or September 19 (stage 2). Rates were 10, 20, 40, 80, 160 pounds TCA acid equivalent in 160 gallons water per acre. Each treatment was done on duplicate 100 sq. ft. plots. Within five weeks after stage 1 treatments, there was no visible grass growth in plots treated with rates higher than 20 lb. per acre. Density of couch grass stand in plots receiving 10 or 20 lb. rates was reduced by about 60 - 70% while growth of annual weeds, stinkweed and pigweeds, was prevalent in all plots. Annual weeds, however, were visibly retarded by the 80 and 160 pound rates. There was no distinguishable difference between TCA formulations used. At the end of the season there was less than 10% of control stand of couch grass in plots treated at stage 1 with 20 or 40 pounds of TCA per acre. Plots with higher rates were still barren of apparently viable grass root material. Effects of stage 2 treatments will be observed in 1952. (Contribution of Department of Plant Science, University of Alberta).

A comparison of the effects of chlorophenyl dimethylurea (C.M.U.), sodium chlorate, borascu, and polybor chlorate on mowed and unmowed couch grass sod. Corns, W. G. On June 25, 1951, when couch grass was 30 inches tall and heading, duplicate 100 sq. ft. plots of dense mowed or unmowed sod at Edmonton were treated with various soil sterilants as follows: CMU 2, 4, 6 ounches per 100 sq. ft. (approximately 54, 108, 216 pounds per acre), sodium chlorate, borascu, and polybor chlorate at 1, 3, 6, 9 lb. per 100 sq. ft. (approximately 435 - 3, 900 lb. per acre). C.M.U. was applied as a spray at 60 gallons per acre. The other chemicals were applied in dry form. Subsequent summer season was very dry. C.M.U. at rates 2 and 3 killed top growth of mowed and intact grass within six weeks and kept ground bare until freeze-up. Rate 1 of C.M.U. was about 90% effective. Sodium chlorate acted more quickly and at rate 2 was completely effective on mowed grass and about 90% effective on unmowed plots. Higher rates kept all plots bare until freeze-up. Borascu was ineffective at all rates used. Polybor chlorate at the highest rate caused slight damage. Observations next year will show whether borascu and polybor chlorate have a much delayed action and whether the good results obtained with C.M.U. and sodium chlorate persist. (Contribution of Department of Plant Science, University of Alberta).

Effectiveness of TCA and endothal for quackgrass control when used with or without plowing. Derscheid, Lyle A. and Kratochvil, D. E. Duplicate square rod plots were treated with TCA at rates of 15, 30, 45, and 60 pounds acid equivalent per acre and with endothal and 2,4-D amine at rates of 8 and 16 pounds per acre. The four rates of TCA were applied in the fall of 1950 on sod and on plowing and they were applied in the spring of 1951 on fall plowed sod. Endothal and 2,4-D were applied in the fall on plowing. Readings made in October, 1951, indicate that the endothal, 2,4-D and spring application of TCA did not give satisfactory control. Fall applications of TCA gave good control whether applied to sod or to plowing. The 15 pound rate gave 70% control on sod and 75% on plowing. All three of the higher rates were equally effective on sod or on plowing and gave over 90% control on every plot. These data indicate that shallow plowing does not increase the effectiveness of fall applications of TCA for the control of quackgrass. (Contributed by the Agronomy Department of South Dakota Agricultural Experiment Station.)

Residual effect of TCA on couch grass. Foster, J. Roe. Trichloroacetic acid was applied to couch grass (Agropyron repens) growing on an uncultivated area on August 15, 1949. The chemical was applied at rates of 80 and 150 pounds per acre. Both these treatments killed all top growth and no grass grew during 1950. In 1951 the grass began to grow again, and by September it was difficult to see where the treatments had been made. (Contribution from the Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada).

Effect of sodium TCA sprayed at different dates on couch grass (Agropyron repens) in 1950. Friesen, H. A. and Harris, H. D. Couch grass plots were sprayed with 90% TCA at rates of 20, 40, and 80 lbs. of acid equivalent per acre. The sprayings were made at 2 week intervals, beginning on June 29 and ending on August 15. Although each treatment resulted in excellent top growth kills, the time required to effect the kills was some 10 days less if the treatments were made in August rather than in June or July. On the basis of the observations on regrowth made in the fall of 1950 and 1951, the treatments applied on August 2 (at this date the couch grass was just beginning to set seed in 1950) were the most effective. Regrowth on these plots was limited to a few scattered shoot, with exception of the 20 and 40 pound dosages

where it was 5 and 1 percent respectively. Treatments made at each of the other dates showed recovery ranging from 10 to 100 percent depending on the dosage applied. (Contributed by the Dominion Experimental Station, Scott, Saskatchewan).

Effect of TCA and tillage on couch grass (Agropyron repens). Friesen, H. A. and Harris, H.D. Sodium TCA was sprayed on couch grass plots in June, 1950 at dosages of 20, 40 and 80 pounds of acid equivalent per acre. Tillage was carried out in conjunction with the treatments in the following ways: (1) plowed and then sprayed, (2) plowed, sprayed, and then hoed 2 weeks after spraying, and (3) sprayed and plowed immediately after spraying. By October, 1950, the regrowth on those plots subjected to treatments 1, 2, and 3, and dosages of 20 pounds of TCA was 25, 25 and 60 percent. At the 40 pound dosage the regrowth did not exceed 5 percent. At the 80 pound dosage only a few scattered shoots were found. In 1951 the land was cultivated in the early spring and sown to Ajax oats. Regrowth was not observed until after harvest. The plots which had received the 20 pound dosages and treatments 1, 2, and 3 had 18, 25, and 38 percent regrowth, respectively. Treatments 1, 2, and 3 and dosages of 40 and 80 pounds had only 6, 4, and 12 percent regrowth respectively. Plots of couch were mowed and sprayed in June, 1950, and resprayed in June, 1951, with sodium TCA at 20, 40, and 80 pounds of acid equivalent per acre. Regrowth on these plots in October, 1951, was 66, 55, and 20 percent, respectively. These results would indicate tillage materially increased the effectiveness of TCA in controlling the couch. (Contributed by the Dominion Experimental Station, Scott, Saskatchewan).

The effect of CMU on couch grass (Agropyron repens). Friesen, H. A. and Harris, H. D. Duplicate plots, one square rod in size were treated with a knapsack sprayer using water solutions of CMU (3-p-chlorophenyl-1-1-dimethylurea) at dosages of 20, 40, 80, and 100 pounds per acre. The treatments were made at two dates, viz: (1) on May 18, when the couch was in rapid growth stage and (2) on July 26, when the couch was fully headed and setting seed. At date 1, the herbicide at each dosage was slow in action, the top growth turned greenish yellow 2 weeks after treatment and one month after treatment it was dead. In October there was no sign of recovery following the application of the 80 and 100 pound dosages. Excavations to a depth of 8 inches revealed that the roots were essentially all dead and decayed. At the 40 pound dosage there were 8 percent of green shoots in evidence and an estimated 20 percent of the rootstalks appeared to be viable. The plots receiving the 20 pound dosage had some 25 percent green regrowth while some 40 percent of the rootstalks appeared to be viable. At date 2 the plots were mowed prior to treatment. The couch began turning greenish yellow 12 days after the treatments were made. In October there was still a tinge of green on each of the plots and excavations showed that the rootstalks were affected but not as yet dead. (Contributed by the Dominion Experimental Station, Scott, Saskatchewan).

The response of quack grass (Agropyron repens) to TCA and cultivation. Helgeson, E. A. and Kratochvil, D. E. A heavily infested area of quackgrass (Agropyron repens) was plowed and disced October 16 and 17, 1950. TCA at rates of 40, 80, 100, or 120 pounds active ingredient per acre was applied to ½ rod by 1 rod plots, using four replications on October 19, 1950. The soil type was Fargo clay and the entire area was flooded during the spring, 1951. All rates of TCA showed 70% elimination of quackgrass or better on August 24, 1951. Averages of four replications were 40 pounds per acre--73% elimination, 80 pounds--79%, 100 pounds--81%, and 120 pounds--79%; however, two of the replications fell on some what higher ground than the rest

and the average per cent elimination on these replications was 100% for 120 lbs., 95% for 80 lbs., and 88% for 40 lbs. per acre. The regrowth present on all replications and rates was predominately seedling growth. (Contributed by Weed Investigations, BPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station).

The effect of C.M.U. on couch grass. Knowles, George. C.M.U. was applied on couch grass sod on May 5 at these rates: 20, 40, 80, and 100 pounds per acre. All these rates gave 100 per cent control of couch grass. This chemical acts slowly and for a time the 20 pound rate appeared too light. However, at the end of two months the control was complete for all rates. Examination of the couch roots showed complete disintegration. It appears that when C.M.U. is applied at the above rates, the residual effect remains in the soil for at least four months. C.M.U. has been applied this fall at the rates of 15, 20, and 30 pounds per acre on couch grass sod, on couch grass sod then ploughed down, and on couch grass sod after ploughing. The residual effect of each of these treatments will be determined in the spring of 1952. (Contributed by Central Experimental Farm, Ottawa, Ontario.)

Response of quackgrass (Agropyron repens) to TCA and cultivation. Lee, Oliver C. Replicated plots of quack grass were treated with TCA using three rates: 30, 60, and 90 pounds of the pure sodium salt. Applications were made during June of 1950. Soil was moist at that time. Observations were made the spring of 1951. The 60 and 90 pound rates produced a 99 percent kill of the quackgrass. Approximately 10 percent of the original stand of grass remained on the plots treated with 30 pounds. Other plots were cultivated before TCA was applied. A rate of 20 pounds, following cultivation, produced a 99 percent kill of quackgrass. Three cultivations, one in July and two in August, killed 90 percent of the quackgrass without the application of TCA. (Contributed by the Department of Botany and Plant Pathology, Purdue University, Lafayette, Indiana.)

Effect of ACP grass killer (TCA 90%) on quackgrass, 1951. Pavlychenko, T. K. Plots 9 x 12 feet in size were laid out on a solid sod of quackgrass (Agropyron repens) growing on silty clay loam soil. ACP grass killer was applied at rates of 25, 50, 75, 100, and 200 pounds per acre in 70 gallons of water per acre, when the grass was in the flowering stage. The plots were divided into three ranges before treatment. The first range was left undisturbed; the second was mowed, and the third was mowed and then thoroughly cultivated to a depth of 6 inches. Treatments were then immediately applied across the three ranges. Results: forty-nine days after treatment, all plots showed 100% topkill. The undisturbed range showed 2, 1, 0.5, 0, and 0 percent regrowth with 25, 50, 75, 100, and 200 pounds per acre, respectively. The mowed range showed 1.5, 1, 0.5, 0, and 0 percent regrowth. The range that was mowed and cultivated before treatment showed the least regrowth, with the amounts being 1, 0, 0.5, 0, and 0 percent respectively. In all plots, this regrowth arose from the rhizomes, which at this time were not dead, but showed strong discoloration, especially in the higher rate plots. Final notes on regrowth, and on the condition of the roots, will be taken in 1952. (Contributed by Agricultural Division, American Chemical Paint Company, Saskatoon, Saskatchewan).

Response of quackgrass (Agropyron repens) to ACP grass killer (TCA 90%). 1950-1951. Pavlychenko, T. K. A series of quackgrass plots was established in 1950. The infestation was sodded for many years, solid and vigorous. Without disturbing the weed by previous cultivation, the plots, 8 x 12 feet were treated at the heading stage with 25, 50, 75, 100, 125, and 150 pounds per acre as top spray. Results:

in 1950, one month after treatment, the top growth turned strawy pale and later in the season it dried out and died. Only in the low rate plots some plants retained "greenish color" on the stems and occasional leaves. At the end of the 1951 growing season, very careful notes were taken. The treatments may be roughly broken into two quite distinctive groups: ineffective and effective. 25 and 50 pounds per acre rates gave unsatisfactory kill from a practical point of view. In 25 pounds per acre treatment, the regrowth in 1951 was almost equal to the original stand. In the 50 lbs. per acre plots, only 25% of the original stand survived. This, however, is fully sufficient to seriously reinfest the area, probably by 1952. The range of effective treatments was from 75 to 150 pounds per acre. In these treatments, no surviving plants or new shoots or seedlings were recorded in 1951. The heavy stand of annual weeds over the area of effective treatments probably was, at least in part, responsible for the complete absence of quackgrass seedlings at this time. (Contributed by Agricultural Division, American Chemical Paint Company, Saskatoon, Saskatchewan).

Response of quackgrass (Agropyron repens) to ACP grass killer (TCA 90%). 1949-1951. Pavlychenko, T. K. This experiment runs in series. One of these was started in 1949. Results from this series up to 1950 were reported on page 14 of the 1950 Research Report of the W.C.S.W.C.C. At this time only further developments in these plots during the growing season of 1951 will be mentioned. In the 1950 report on this it was stated that "rates upward of 75 pounds per acre virtually eliminated the original stand of quackgrass". Some runners, however, had escaped the kill and started to produce scattered shoots. New seedlings also began to appear in 1950 in all plots. In 1951 the shoots from the surviving runners and especially from new seedlings, became very numerous and even 200 pounds per acre plots are seriously reinfested. This indicates the necessity of careful cultivation or spot treatments of the land after it has been freed from quackgrass by TCA treatments. (Contributed by Agricultural Division, American Chemical Paint Company, Saskatoon, Saskatchewan).

CMU for quackgrass control. Peters, R. A. and Willard, C. J. CMU was applied on April 16, 1951 to a quackgrass sod on a Brookston soil at Columbus, Ohio. Rates of 0, 12.5, 25, 50, and 100 pounds per acre of the commercial salt in 80 gallons of water were applied on plots 14 by 14 feet replicated three times. Nonic 218 at .1% was used as a dispersing agent. The action of the CMU was slow. By July 19, 1951, the plots which received the 100 and 50 pound rates were completely bare and most of of the rhizomes were dead. On September 8, 1951, the percent control was 100, 98, 50, 25, and 12.5 pound rates, respectively. Corn and soybeans planted on July 6, 1951, did not survive. (Contributed by Ohio Agricultural Experiment Station.)

Time of application of sodium TCA for quackgrass control. Peters, R. A. and Willard, C. J. Applications of sodium TCA were made in October and November of 1950 and in January, February, April, and May of 1951 on an established sod of quackgrass on a Brookston soil at Columbus, Ohio. Rates of 0, 10, 20, 40, and 80 pounds acid acid equivalent, per acre, were applied in 40 gallons of solution on plots 7 by 14 feet replicated three times. The April and May applications included one series with TCA only and another with TCA plus .1% Nonic 218. As rated on June 15, 1951, the cold weather applications were ineffective in terms of top growth control as compared to the April and May applications. The October, November, January, and February applications reduced the elongation of the stem internodes and amount of bloom in proportion to the rate applied. Height reduction varied from 10% at 10 pounds to 50% at 80 pounds. Bloom was entirely prevented at 40 and 80 pound rates. As high as

80% kill of top growth was obtained following the April applications. Flowering was prevented at all rates. Nearly complete recovery was noted by August 20 on all plots treated in April and earlier. The May 28 applications, which were made in the late boot stage, gave 100, 90, 50, and 10 percent top growth kill at 80, 40, 20, and 10 pound rates, respectively, on August 20, 1951. No effect on top kill observed from the use of Nonic 218 as a wetting agent. (Contributed by Ohio Agricultural Experiment Station.)

Control of quackgrass in established alfalfa using sodium TCA. Peters, R. A. and Willard, C. J. Sodium TCA was applied to an established alfalfa-quackgrass stand on Miami soil at Columbus. Rates of 0, 10, 20, 40, and 80 pounds per acre, acid equivalent, were applied July 18, October 12, and November 15, 1950, and on April 5, 1951, on plots 14 by 14 feet replicated three times. The July application initially gave complete top kill of quackgrass at rates of 20 pounds and above with very little damage to the alfalfa. In the spring of 1951, however, the alfalfa density was reduced to 10% and 50% of the check at the 80-pound and 20-pound rate respectively. As of September 17, 1951, there was 0, 25, and 75 percent recovery of quackgrass at the 80, 40, and 20 pound rates respectively. In the October application some temporary effects were noted in the spring of 1951, but by June 7, 1951, no evidence of treatment could be seen in either the quackgrass or the alfalfa. The November application had no effect on either species. The April treatment resulted in a 80-90 percent quackgrass top kill at all rates. However, by August 16, 1951, there was complete recovery at the 10 pound rate, ten to twenty percent recovery at the 20 pound rate, and no recovery at the 40 and 80 pound rates. The alfalfa density and height was only slightly decreased at the 10 and 20 pound rate. At the 40 and 80 pound rates, the height of growth decreased one-half and two-thirds respectively, although there was little change in density. By August 16, 1951, the alfalfa was normal in all plots except for greater leafhopper damage at the higher rates of TCA. (Contributed by Ohio Agricultural Experiment Station.)

A comparison of TCA formulations for quackgrass control. Peters, R. A. and Willard, C. J. Three TCA formulations, sodium TCA, calcium TCA, and TCA acid in oil were applied on May 10, 1951, on a quackgrass sod about 9 inches tall in the late boot stage Rates of 25 and 50 pounds per acre acid equivalent, were applied on plots 7 by 265 feet replicated twice. The salts were applied in 40 gallons per acre of No. 1 fuel oil. On June 25, 1951, the 25 pound rate on all formulations had killed all top growth but the stem bases. Flowering was reduced and many spikes were malformed upon emergence. At the 50 pound rate the TCA acid gave complete top kill while the salts did not kill the stem bases. Flowering was prevented by all formulations. On September 11, 1951, considerable recovery at the low rates had occurred. The densities at the 25 pound rate were 75, 75,, and 25 percent of the check from the sodium salt, calcium salt and TCA acid, respectively. There was no apparent advantage of the acid at the 50 pound rate, since no plot had more than 10 percent density. (Contributed by Ohio Agricultural Experiment Station).

Eradicating couch or quackgrass with TCA and CMU. Wood, H. E., Silversides, W. H., and Watson, W. D. In Winnipeg a series of three one square rod plots of dense quack, after mowing, was knapsack-sprayed two weeks before freeze-up in 1950, with sodium TCA at 40, 80, and 120 lbs. acid per acre. The soil was heavy clay and quite moist. Very considerable growth appeared in early spring and onward on the 40 lb. plot; only a stray shoot on the other two plots until past mid-summer and then only limited regrowth. In the same area, May 14 and August 23, 1951, replicate series

of plots of quack were sprayed with CMU at 20, 40, 60, and 80 pounds of acid per acre (August spraying 20, 30, 40, and 60 lbs.) using one imperial gallon water per plot. May to July was umusually dry, although the soil was quite moist when it was sprayed, thereafter frequent rains fell. Action of the chemical was quite slow in contrast to TCA, requiring 6 to 8 weeks to bring about a kill. A complete kill of quack appears to have been obtained at the two heavier rates, almost complete at 40 pounds with a large measure of control at 20 pounds. August treated plots showed promising results at the time of killing frosts. (Contributed by Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada).

PROJECT I CONTROL OF PERENNIAL HERBACEOUS WEEDS.

Johnson Grass (Sorghum halepense) Investigation Leader: Oliver C. Lee

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Among the herbicides showing promise for the control of Johnson grass are, sodium chlorate, polybor chlorate, Borascu, TCA and CMU. Rates and time of application for best kill will vary. TCA can be effectively applied during fall or spring months. Spring applications are most effective in controlling seedlings. Experiments have indicated that TCA is translocated through the plant, however, applications applied to stubble are effective. Chemical treatments, cultivation and clipping all affect rhizome development.

Abstracts of Results of Individual Cooperators.

Johnson Grass Control with Chemicals. Elder, W. C. and Gassaway, J. E. Several chemicals at different rates were applied on Johnson grass in August and November, 1950 and March, 1951. 4 lb. per sq. rod of sodium chlorate killed the established grass and kept the seedlings under control for 1951. 8 lb. polybor chlorate per sq. rod gave similar results as 4 lb. sodium chlorate for the first year. 15 lb. per sq. rod of concentrated Borascu did not kill all Johnson grass when treated in March, 1951, while 20 lb. was sufficient. August and November treatments of 15 lb. Borascu killed all Johnson grass plants in 1951 and did not allow annual grasses to develop as in the sodium chlorate and polybor chlorate treatments. T.C.A. applied as a spray at the rate of 100 lb. per acre killed the established Johnson grass in the August and November treatments. 100 lb. T.C.A. per acre did not completely kill Johnson grass when applied in March. All T.C.A. plots were badly infested with Johnson grass seedlings early in the summer of 1951. Corn planted in May, 1951 on plots that were treated with 50 lb. and 100 lb. of T.C.A. per acre in November, 1950 produced a normal crop without apparent injury to the crop, however Johnson grass seedlings were a problem by June. 80 lb. per acre of C.M.U. applied in March kept all Johnson grass and seedlings from developing in 1951. 20 lb. C.M.U. was not sufficient for effective control and the 40 lb. rate gave only 75% control. (Contribution of the Agronomy Department, Oklahoma Experiment Station, Stillwater, Oklahoma).

Relative effectiveness of TCA when applied to top growth and Stubble of Johnson grass (Sorghum halepense) Oyer, E. B. and Lee, Oliver C. Rates of 60, 80 and 100 pounds of TCA, pure sodium salt, were applied as foliage sprays and on stubble after clipping. Plots were sprayed July 19, 1950 when Johnson grass was approximately 18 inches in height. On one series of plots the top growth was not removed while on another all top growth was clipped off to a height of 2 inches. Results were rated on July of 1951 on the basis of plants remaining on plots as compared to the check area. Using 10 as a rating for the check plots treatments and results were as follows: TCA 60 pounds per acre on foliage was 1.5 as compared to 0.5 for stubble treatment. The 80

pound rate gave 1.2 on foliage as compared to 0.5 on stubble. The 100 pound application like wise was in favor of the stubble treatment being 2.8 for foliage application as compared to 1.1 for stubble treatment. Other experiments indicate best results with TCA were obtained when applied in two treatments some 60 days apart. (Contribution of the Department of Botany and Plant Pathology Purdue University, Lafayette, Indiana.)

Effect of sodium TCA upon and established alfalfa-Johnson grass mixture. Peters, R. A. and Willard, C. J. Applications of sodium TCA were made on August 29, October 7, November 18, 1950 and on March 31 and June 16, 1951 on a three-year old alfalfa stand on a Genessee soil near Waverly, Ohio. Rates of 0, 10, 20, 40 and 80 pounds, acid equivalent, per acre in 40 gallons of solution were applied on plots 14 by 30 feet replicated three times. At the time of the first cutting in June, 1951 only the August 1950 and the March 1951 applications showed any treatment effects. On July 4 the percent of alfalfa on plots treated in August 1950, based on hand separation of the mixture, was 54, 78, 82, 53 and 13 at rates of 0, 10, 20, 40 and 80 pounds per acre, respectively. The low percentage at the 80 pound rate was due to the heavy stand of Johnson grass seedlings which came into the nearly bare plots after the death of most of the alfalfa following treatment. At the 10 and 20 pound rates the alfalfa was normal and the total alfalfa yield was higher. However, August 25, 1951 treatment effects were no longer apparent. The March applications killed over 75 percent of the alfalfa at all rates. Additional applications were made June 16, 1951. On July 4, hand separations showed 58, 77, 86, 91 and 96 percent of alfalfa at rates of 0, 10, 20, 40 and 80 pounds per acre, acid equivalent, of TCA, respectively. There was enough injury to the alfalfa at the two high rates to decrease the total alfalfa yield compared to the check. Following the third cutting, however, the alfalfa was normal at all rates and there was no Johnson grass at the 40 and 80 pound rates. (Ohio Agricultural Experiment Station.)

Control of Johnsongrass with sodium TCA applied during the dormant season. Peters, R. A. and Willard, C. J. Sodium TCA was applied on October 28, 1950 and on March 31, 1951 on a dormant stand of Johnsongrass on a Genessee soil near Waverly, Ohio. Rates of 0, 10, 20, 40 and 80 pounds acid equivalent, in 40 gallons of solution per acre were applied on plots 7 by 60 feet replicated three times. The March application included one series with the TCA salt only while the other series included .1 percent of Nonic 218. Half of each plot was plowed and planted to corn on April 23, 1951. There was no evidence of injury to the corn except at the 100 pound rate including the wetting agent. The October 28 applications were ineffective in decreasing growth in the spring of 1951. The late March application, however, gave a high degree of control. No growth from the rhizomes occurred following the 20, 40 and 80 pound applications while only a few culms emerged at the 10 pound rate. There was no seedling development until June 18, 1951 but by late summer all plots were completely revegetated by seedlings. (Ohio Agricultural Experiment Station.)

Effect of combined TCA and cultural treatments on the yield of Johnsongrass rhizomes. Peters, R. A. and Willard, C. J. Sodium TCA applications at rates of 20, 40, 80 and 160 pounds, acid equivalent, per acre, were made the middle of May, June, July, and August of 1950 on each of six cultural treatments of an established Johnsongrass stand near Waverly, Ohio. (See NCWCC Research Report, 1950, page 21.) In the early spring of 1951 samples of dormant rhizomes were dug to a depth of 10 inches. Not all rates of TCA nor all cultural treatments were sampled, but the following results were obtained, on the basis of fresh rhizome weights from three replicates. All TCA treatments in May caused over a 50 percent or greater reduction in rhizome weight, the greatest reduction being from 3000 grams per square yard on the untreated plots to 90 grams per square yard following a 160 pound application after plowing. All plots, including the checks, were mowed before the August applications. This had a marked effect. The weight of rhizomes on the mowed check plot was 800 grams per square yard compared to 2500 in the non-mowed plots. The August TCA treatments lowered the rhizome weight as compared to the mowed check, but not significantly. The rhizome weights in the 20 and 80 pound plots were lower than in the corresponding May treated plots. Plowing in August resulted in a consistent reduction in rhizome weight at all rates of applying TCA as well as in the check. TCA applied in May combined with all-season fallowing gave complete eradication at the 80 pound rate. Fallowing before and after the August treatments was only slightly more effective than a single plowing at the time of TCA application. All plots, including those in which the rhizomes were eradicated, were revegetated by July 1, 1951 from Johnsongrass seedlings. (Ohio Agricultural Experiment Station.)

Effects of sodium TCA on the development of Johnsongrass rhizomes. Peters, R. A. and Willard, C. J. Following applications of sodium TCA to dormant Johnsongrass the rhizome buds develop into abnormally thickened 'stubs' with shortened internodes and restricted elongation. The apical tissue usually either dies or forms a disorganized mass of meristematic cells. If growth has started when the TCA is applied the terminal bud will be the first one affected. Subsequently, laterals may start growing, but the growth is usually restricted. Treated rhizomes and the 'stubs' which have grown from them usually remain static for weeks with disintegration gradually setting in. When foliar applications of sodium TCA were so made as to preclude TCA reaching the soil, the rhizome buds showed the same response as when directly exposed to the TCA. Translocation of the TCA is thus indicated. The addition of Tween 20 as a wetting agent increased the amount of translocation. (Ohio Agricultural Experiment Station.)

CMU for Johnsongrass control. Peters, R. A. and Williard, C. J. CMU was applied May 17, 1951 on an established stand of Johnsongrass on Genessee soil near Waverly, Ohio, as the grass was emerging. Rates of 0, 12.5, 50 and 100 pounds per acre of the commercial salt were applied in 80 gallons of H_2O on plots 7 by 30 feet replicated three times. Nonic 218 at 0.1% was added as a dispersing agent. The action of the CMU was

slow. On July 18, 1951 the control obtained was 100, 90, 50 and 0 at rates of 100, 50, 25 and 12.5 pounds per acre. At the 25 pound rate 25% of the plants had bloomed while none bloomed at the 50 pound rate. On August 25, 1951 no Johnsongrass had appeared on the 100 pound plots, while at 50 pounds there was some recovery from rhizomes with an average of one crown per 10 square feet. There was considerable recovery at the 25 pound rate while the Johnsongrass at the 10 pound rate continued to compare with the check. In no case was there any seedling reinfestation. Corn and soybeans planted on June 16 developed normally up to 3-4 inches, when the plants died within a few hours. (Ohio Agricultural Experiment Station.)

Johnson grass: development of the root system of the seedling. Russ, O. G. and J. W. Zahnley. Seed was planted in rows on June 1, 1950, to provide plants for study. Plants were randomly sampled at two week intervals to observe the number, length and direction of rhizome development. Seedlings removed after two months of growth had produced enough rhizome material so they could be classified as a perennial in habit of growth. About heading time, there was a downward movement of the rhizomes which continued until plant growth had ceased in the fall. Plants varied somewhat in the amount and depth of this downward movement. The average depth of penetration was approximately eighteen inches, with some being as much as thirty inches. The area of heaviest concentration was in the top eight inches of soil. A very small percentage of deterioration took place during the winter dormant period. On April 27th the nodes of the rhizomes had begun to swell which was an indication of resumption of growth. One week later many of the buds had developed into new growth which was directed toward the surface of the soil. Fibrous roots also had begun to develop at the nodes and were directed downward. (Contribution of the Department of Agronomy, Kansas State College).

Project 1. Control of Perennial Herbaceous Weeds.

Leafy Spurge — Thomas K. Pavlychenko

SUMMARY

The work on leafy spurge in 1951 as reported in 12 abstracts submitted and included in this summary may be conveniently classified with respect to the materials or methods used as follows:

1. Treatments with 2,4-D or 2,4-D and 2,4,5-T mixtures; with MCP, TCA and CMU (Chloro-methyl-urea).
2. Treatments with soil sterilants, borascu, polybor, polybor-chlorate, sodium sulfamate, sodium chlorate and chlorax.
3. Tillage treatments.

With respect to the principal objectives of the research the majority of the abstracts contain empiric records of the top kill and regrowth in field plots under various climatic and soil conditions. Three co-operators, however, made an attempt this year to either adopt a new technique in applying the materials or to study fundamental problems. Heggeness and Miller, for instance, devised a special method of treating the roots of the weed. Derscheid and Kratochvil treated the weed at the dormant stage in October. Pavlychenko in two separate projects studied the extent of downward and lateral translocation of different materials in relation to regrowth.

The results from 2,4-D treatments were reported by A.D. Brown, Experimental Station at Brandon, Man., D.E. Kratochvil, Agronomy Dept. South Dakota., T.K. Pavlychenko Research Station of American Chemical Paint Co., Saskatoon, Sask., E.P. Sylwester and O.H. Hoffman, Iowa State College, H.A. Craig and H.E. Wood, Weeds Commission, Winnipeg Man., and H.G. Heggeness and J.H. Miller, University of Minnesota.

The above workers used 2,4-D either in a form of amine salts or esters at various dates and rates. From their reports it appears evident: (1) that, at comparable rates and dates, esters were invariably more effective than amine salts. (2) rates in excess of 2 lbs./a. usually gave a more complete top kill and prevented regrowth for a longer time. (3) some regrowth was observed in all the treatments, irrespective of rates. (4) regrowth was quite abundant and vigorous in all plots treated prior to or at the bud stage. (5) treatments at the late bloom or at the seed setting stages were more effective both in killing the tops and roots and in preventing the new shoots. (6) repeated treatments at lower rates ($\frac{3}{4}$ and 1 lb./a) were more effective than single treatments at much higher rates. (7) mineral fertilizers added to 2,4-D treatments did not increase their effectiveness but gave an appreciable support to the crop in competition with the weed. (8) T.K. Pavlychenko used extensively low volatile ester (butoxyethanol of 2,4-D with the results equal or sometimes better than those obtained with ordinary esters.

In the light of the data reported, TCA and CMU were insufficiently effective on this weed to be of practical importance until further evidence to the contrary will become available.

Mixtures of 2,4-D and 2,4,5-T were tested by F. Bisal, Dominion Experimental Station at Swift Current, Sask., D.E. Kratochvil, T.K. Pavlychenko and P. Sylwester and Hoffman. Bisal using 2:1 mixture of butoxyethanol esters killed "all top growth" with no regrowth in September 1951. Kratochvil obtained 50, Pavlychenko 93 and Sylwester 90 pct. reduction in stand.

Soil sterilants were used by Brown, Lyle A. Derscheid, Sylwester and Wood. In all cases from 90 to 100 pct. reduction in stand was obtained with borascu, sodium chlorate and polybor if used at high rates sufficient to give prolonged sterility to the soil (5 to 10 years). Ammate was somewhat erratic in its action and chlorax showed low effectiveness.

Tillage was extensively tested at Brandon, Man. and it gave a complete eradication of the weed after two years of black summerfallow.

Some abstracts do not give information on the plot size. It appears that one square rod or less was used in most cases. In view of the fact that the underground roots of leafy spurge, if disturbed in any way, extend quite readily for 6 feet or more into the new ground in one season, it appears that even one rod square plots are too small for obtaining truly dependable results. This matter should be given very careful attention by the research committee in connection with all experiments involving perennials with extensive subterranean runners.

CHEMICAL control of leafy spurge. Brown, D.A., (1) Experiments have been underway since 1934. Prior to the introduction of selective herbicides sodium chlorate, Atlacide and Weed-Ex were used. Rates ranging from five to fifteen hundred pounds per acre of these products were applied as dry powder as well as in water solution. RESULTS: Two applications per year, the first in September and the second in June were found to be much more effective than one application made either in early summer or in the autumn. These treatments killed the spurge 100 per cent, but the soil was so sterilized that no grain was produced for at least six years and no alfalfa for eight to ten years. (2) From 1945 to 1947 inclusive, various formulations of 2,4-D were applied to dense stands of spurge. Single treatments were given at rates of one to five pounds acid equivalent per acre when plants were in bud. RESULTS: The top growth was killed back, but the stand recovered almost completely within one year. (3) In 1948-49 an elaborate plot test was laid down where formulations of sodium salt, amine and ester of 2,4-D were used at rates of one to two pounds acid per acre, as spring rosette, pre-bud, full bloom, post bloom and fall rosette treatments. In one range the treatments were repeated three to five times, or as long as plants persisted. RESULTS: Single dosages killed back top growth but very little root injury occurred. Regrowth was almost 100 per cent in all treatments regardless of the stage of growth at the time of application. Three to four repeated treatments even at one pound per acre killed the spurge outright 90 to 100 per cent. The results were much less satisfactory where butyl ester was used at 2 lbs./a. rate after each of the three cultivations in one season. (Contributed by Dom. Experimental Farm, Brandon, Man.).

TILLAGE control of leafy spurge. Brown, D.A., Two successive years of summerfallow on which the weed was never allowed to establish above-ground growth have given complete eradication except for scattered reinfestation by means of seedlings. Seeding infested fields with brome and crested wheat grass and using the crop for pasture and hay for from five to ten successive years has kept the spurge under control but has not substantially achieved eradication. (Contributed by Dom. Experimental Farm, Brandon, Man.).

RESPONSE of leafy spurge to treatments with a misture of 2,4-D and 2,4,5-T, 1951. Bisal, F. Plots of leafy spurge (Euphorbia esula) were treated with a mixture of 2,4-D and 2,4,5-T (Weedone Brush Killer 32) at the rate of 1 lb./a. in the growing season of 1951. RESULTS: In September of 1951, all top growth of the weeds was killed. There was no regrowth present at this time, but as the roots did not appear to be completely killed, it is reasonable to assume that they may send up new shoots next spring. Final readings on regrowth will be taken in 1952. (Contributed by Department of Agriculture, Swift Current, Sask.).

EFFECTIVENESS of 2,4-D applications on dormant leafy spurge. Derscheid, Lyle A. and D.E. Kratochvil. Duplicate square rod plots were treated with an alkanol amine, an ethyl ester, a butoxyethanol ester, an acetanalide and a micronized acid of 2,4-D at rates of 4, 8 and 16 lbs. acid equivalent per acre. Treatments were made October 30, 1950 when the spurge was dormant. Readings made July 1951 indicate that the two heavier rates of the amine and ethyl ester gave 70% control, while none of the other treatments gave over 50% control. Although 70% control is unsatisfactory, it is the best control that has been obtained with a single application of 2,4-D in South Dakota. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.).

EFFECTIVENESS of several heavy chemicals for control of leafy spurge. Derscheid, Lyle A. Duplicate 9' x 15' plots were treated with borascu at rates of 15 and 20 lbs. per sq. rd., conc. borascu at rates of 5, 10 and 15 lbs., polybor

at rates of 4, 8, 12 and 16 lbs., polybor-chlorate at 4, 8, 12 and 16 lbs., sodium chlorate at 5 lbs., sodium sulfamate at 2 and 4 lbs. per sq. rod., with CMU (chloro-methyl-urea) at 5, 10, 20, 40 and 80 lbs. per acre, EC3890 (sodium trichloroacrylate) at 5, 10, 20 and 80 lbs. per acre and with TCA at 20, 40 and 80 lbs. per acre. Treatments were applied June 29, 1951 and readings were made September 18. Complete elimination of leafy spurge was obtained with a minimum rate of 15 lbs. of borascu, 10 lbs. of conc. borascu, 12 lbs. of polybor, 12 lbs. of polybor-chlorate, 5 lbs. of sodium chlorate and 4 lbs. of sodium sulfamate. CMU, TCA and trichloroacrylate did not give complete elimination at any rate. Borascu, conc. borascu, polybor-chlorate were applied at similar rates in October 1950, and similar results were obtained. (Contributed by Agronomy Department of South Dakota Agricultural Experiment Station.).

EFFECT of systemic herbicides on leafy spurge (Euphorbia esula). 1951. Pavlychenko, T.K. One series of 16x24 ft. plots were treated in duplicate on June 30th, early flowering stage, with esters of 2,4-D (Weedone Concentrate 48, straight and reduced to 10 pct. acid eq., ACP649); low volatile ester (Weedone LV4); mixtures of 2,4-D and 2,4,5-T (Weedone Brush Killer 32), and Amine of MCP (Weedar), at 2 and 4 lbs./a. rates. A similar series was treated on July 26th, late flowering stage, with the same chemicals, at 3 and 6 lbs./a. rates. RESULTS: On Sept. 13th, the foliage was 100 pct. killed in both series excepting a very low kill by MCP. Stems were practically 100 pct. killed in the late series by all chemicals but MCP. In the early series, no chemical gave 100 pct. top kill, irrespective of the rates used, with the best results in B.K. 32, 2 lbs./a. rate (93 pct.), Weedone LV4, 4 lbs./a. (88), LV4 reduced to 10 pct. acid eq. (83), W.C. 48 reduced to 10 pct. acid eq. (80 pct.). MCP was the least effective chemical in this project with all rates and at both dates. Other treatments in this series gave quite substantial yet agronomically unsatisfactory top kill. The regrowth in the early series was very high, ranging from 58 to 179 pct. of the original stand. In the late series the regrowth was very slight: B.K.32, 6 lbs./a., 6 pct; W.C. 48 reduced to 10 pct. acid eq., 8 pct; W.C.48 straight, 9 pct.; LV4, 12 pct; LV4 reduced to 10 pct. acid eq., 13 pct; the remaining chemicals 16 to 30 pct. Numerous excavations have conclusively proved that only 61 pct. of the new shoots came up from the roots having top growth at the time of treatment, the other 39 pct. having originated from the roots that did not have top growth at that time and thus altogether escaped the action of the chemicals. (contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.).

TREATMENT of leafy spurge (Euphorbia esula) with Weedone LV4. Pavlychenko, T.K. In 1950 an infestation of leafy spurge, in the Saskatoon district, was cultivated once and then treated with various 2,4-D or 2,4-D plus 2,4,5-T formulations at the bloom stage and again when the regrowth was 6 to 8 inches high. In 1951 the land was sown to wheat and sprayed with 2,4 and 8 lbs./a. of Weedone LV4, when the spurge was in flower. RESULTS: In the fall the foliage was dead, but some regrowth was present in all plots. A great many plants were excavated from representative areas in each plot to discover the source of the "regrowth". It was found that in most cases where the stems were killed to the ground level the roots directly connected with these were also dead to a depth of approximately 7 inches. Translocation to the lateral roots varied from 8 to 20 inches. The vegetative buds on the affected root crowns and lateral roots were either dead or arrested in their vegetative activity, so no new shoots were produced within the zone of effective translocation. On the lateral roots beyond the zone of effective translocation the buds were numerous and active. Some of these located near the surface produced occasional shoots. In each plot, however, there were areas where the underground roots and buds were abundant but no top stems present at the time of

treatment. After the treated top growth was killed, the buds that escaped the treatment became very active and the majority of the new shoots was produced from these buds. In the plots treated at 2 lbs./a. rate, for instance, only 26% of the new shoots were produced by the plants having the top growth at the time of the treatment, with 36% originating from the roots, which had no top shoots at that time. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.).

LATE July treatments of leafy spurge 1950-1951. Pavlychenko, T. K. In a crop of wheat on light sandy loam soil, one solid plot of leafy spurge (Euphorbia esula), approximately 50x70 ft. in size was treated on July 19th, 1950 with 2,4-D and 2,4,5-T acids in proportion of 2:1 (ACP926) at the rate of 6 lbs./a. On the same day a plot of similar size and density in the same field, was treated with 6 lbs./a. rates of low volatile ester of 2,4-D (Weedone LV4). RESULTS: On September 19th, 1950 the top growth was 100 pct. killed in the ACP926 treatments. Vertical roots were dead down to 5 inches or more. The horizontal roots also were dead to approximately 5 inches from the treated stems. Only three shoots were found in the entire plot. On Aug. 24, 1951, the treatment was re-examined. The plot was free of leafy spurge. Four very much delayed shoots were recorded on the outskirts of the plot. On September 19th, 1950, the top growth in the Weedone LV4 treatment also was 100 pct. killed. The vertical roots and rhizomes were seriously injured but showed some life beyond the 10 inches distance from the treated stems. There was some regrowth in the plot. On Aug. 24, 1951, the regrowth amounted to approximately 5 pct. of the original stand. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.).

CHEMICAL control of leafy spurge. Sylwester, E.P. and Hoffmann, O.L. Leafy spurge was treated with various chemicals in August of 1950 and the same chemicals were used in adjacent plots in May 1951. Data for 1950 treatments can be considered final; 1951 data are tentative. Data are presented in the following manner: The chemical rate per square rod follows the chemical name, The first percentage figure indicates 1950 reduction in stand; the second 1951 reduction. Borascu, 30 pounds, 100%, 98%; Borascu, 20 pounds, 100%, 98%; Concentrated Borascu, 20 pounds, 100%, 97%; Concentrated Borascu, 10 pounds, 100%, 96%; Polybor, 15 pounds, 100%, 98%; Polybor, 10 pounds, 100%, 90%; Polybor chlorate, 15 pounds, 100%, 98%; Polybor chlorate, 10 pounds, 100%, 94%; Sodium chlorate, 3 pounds, 99%, 55%; Sodium chlorate, 2 pounds, 99%, 45%; Ammate, 2 pounds (1950), 100%; Ammate, 1 pound (1951), 0 Control; CMU, 80 pounds per acre in 1951, 0 Control. Two applications of a 50-50 mixture of 2,4-D - 2,4,5-T ester at a rate of 2 pounds per acre in August 1950 and May 1951 gave 90% reduction in stand. There was a heavy quackgrass undercover in this plot. The 1950 treatments were more effective than 1951 treatments. Seasonal effect on treatment or a heavier rainfall in 1951 may have altered the response. (Contribution by the Botany & Plant Pathology Department, Iowa State College).

CONTROLLING leafy spurge with herbicides. Craig, H. A. and Wood, H.E. Following seven years of extensive trials, in which 2,4-D has been used at varying rates and dates, with generally indifferent to unsatisfactory results, several other herbicides were added in 1950-51 to the trials under way at two locations, one site a heavy clay soil, the other a light loam. Unless otherwise stated, rod-square plots, with a fairly heavy spurge infestation in competition with grass, were knapsack sprayed, using 1 to 3 Imperial gallons water as a dilutant. In July 1950, Polybor-chlorate was applied 3,6,and 9 lbs. per rod to one series; in November 1950: Polybor-chlorate 6 and 9 lbs.; Borascu (dry) 6 and 9 lbs.; Atlacide 4 and 8 lbs.; June 1951, as in November with additions of: Chlorax ¾ and 1 gal.; CMU 1¼,2½, 5 and 10 oz. (active); Atlacide 25 lbs. with the addition of 16 and 30

oz. respectively 2,4-D ester; July 1951, Polybor-chlorate 6 and 9 lbs; Borax (dry) 6 and 9 lbs. In late July 1951, 11 plots were sprayed, using oil-emulsions with and without 2,4-D (1 lb. acid per acre); three high aromatic oils were compared. Only tentative conclusions can be drawn as follows: (1) Polybor-chlorate and Borascu at comparable rates appear as effective as Atlacide which at the higher rates gives nearly complete eradication; (2) Chlorax appears to be less effective; (3) CMU, even at the lowest rate eradicates the grass but appears no more effective than 2,4-D which kills the top growth of spurge but has little effect upon the root system; (4) oil-emulsions appear to have little or no advantage over water. (Contributed by the Weeds Commission, Manitoba Department of Agriculture co-operating with the several companies supplying the materials used.).

A METHOD for the subterranean application of 2,4-D type herbicides for the control of leafy spurge (Euphorbia esula). Heggeness, H. G., and J. H. Miller. 1/ Foliage applications of 2,4-D type herbicides usually kill the aerial portions of leafy spurge but do little permanent damage to the underground parts. Therefore, attempts were made to place the herbicides in the vicinity of the active roots. The sodium and amine salts of 2,4-D, the ester of 2,4-D, and 2,4-D acetanalide were applied in a pasture heavily infested with leafy spurge. The chemicals were mixed with rye seed and drilled into the soil at a depth of about 3 inches (Maximum obtainable with facilities at hand) in July. The rates of application included 2,4,8,12,16 and 32 pounds of acid per acre. Injury was apparent on roots of plants still living this fall which suggests that root applications combined with foliage applications might be more effective than foliage application alone. Observations on other weeds and grasses indicated a more selective action than from foliage spraying. Fall observations also indicated that the difference in response from rates was not great. (Joint contribution of the Minnesota Agriculture Experiment Station and the Division of Weed Investigations B.P.I.S and A.E, U.S.D.A.).

1/ Paper No. 2761, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul 1, Minnesota.

A FIELD study for the control of leafy spurge (Euphorbia esula) with herbicides. Miller, J.H. and H.G. Heggeness. 1/ A pasture area (Hubbard loamy sand) in Hennepin County, Minnesota, comprised mostly of perennial grasses and leafy spurge has been used since 1948 for the study of various chemicals, water volumes, and fertilizers for the control of leafy spurge. Of 25 herbicides studied, the isopropyl ester and dimethylamine salt of 2,4-D appear to be as effective as any of the newer chemicals tried. In most cases, the rate of application was more important than the type of herbicide used, i.e., the 8 pound application was far superior to a 2 pound application in 1951. Fertilizer treatments with ammonium nitrate designed to increase grass competition did not materially affect the response from either 2 or 8 pound application of isopropyl ester of 2,4-D in 1951. However, the grass vigor on the fertilized plots suggested that this situation may be reversed next year. Water volumes (10 and 175 gallons per acre) were compared for 2 and 8 pounds of acid as an isopropyl ester. Higher volumes of water increased the effectiveness of the chemical at the 2 pound rate, but not at the 8 pound rate. (Joint contribution of the Minnesota Agricultural Experiment Station and the Division of Weed Investigations, B.P.I.S. and A.E, U.S.D.A.).

1/ Paper No. 2762, Scientific Journal Series, Minnesota Agricultural Experiment Station, St. Paul, 1, Minnesota.

Project I. Control of Perennial Herbaceous Weeds.

Field Bindweed — Investigation Leader: V. W. Woestemeyer

Summary

Three abstracts of reports on field bindweed control were submitted from two sources. One report was on the effect of combinations of 2,4-D and cultivation. Where the bindweed was cultivated intensively until eradicated with a 2,4-D treatment at 1½ pounds per acre of the amine or ester form sometime during the first season, about the same number of cultivations, 16 to 18, were required as where no 2,4-D was used. Where the 2,4-D was applied in the spring after one season of cultivation, the total number of cultivations was reduced to an average of 13. There was no consistent advantage for one formulation over the other.

A report on the effect of CMU shows that 40 to 80 pounds per acre as a post emergence treatment gave complete control of field bindweed grown in nursery plots. Twenty pounds gave 50% control.

In a bindweed seedling experiment some plants that emerged in the spring of 1950 were treated in the fall, and others the following spring. The amine, ester and low volatile ester forms were used. Average survival from fall treatments was 15%, with 2/3 pound ester giving complete control. There was an average survival of 46% from spring treatments, with no treatments giving complete control. The amine and low volatile ester forms appeared to be as effective as the ester at the 1/3 pound rate.

Abstracts of Results of Cooperators

The effect of CMU on field bindweed. Knowles, Geo. CMU was applied as a post emergence treatment as the rates of 20, 40 and 80 pounds per acre on field bindweed (Convolvulus arvensis). This weed was completely controlled by the 40 and 80 pound rates. Approximately 50% control was obtained by the 20 pound rates. It should be noted that the above treatments were applied on field bindweed growing in a nursery plot. (Central Experimental Farm, Ottawa, Ontario.)

The effect of combinations of 2,4-D and intensive cultivation in eradicating field bindweed. Russ, O. G., and J. W. Zahnley. Experiments were started in 1948, 1949 and 1950 to determine the effect of 2,4-D in combination with intensive cultivation in eradicating field bindweed. Six duplicate treatments were started each spring, varying from spraying in the spring followed by cultivation as needed to complete eradication, to spraying in the spring after a season of intensive cultivation followed by cultivation as needed. Half of each plot is sprayed with 1-1/2 pounds of sodium salt per acre and half with 1-1/2 pounds of ester per acre. The 1948 and 1949 treatments have been carried to completion. A total of 16 to 18 cultivations were required to complete eradication on those plots receiving a treatment of 2,4-D sometime during the first season. The length of time and number of cultivations necessary to eradicate the bindweed was essentially the same as that for intensive cultivation only. The length of time required was slightly over two years. The treatment which consisted of one year of intensive cultivation followed by spraying in the spring has required an average of 13 cultivations over a two year period. There has been no consistent advantage for one formulation of 2,4-D over the other. (Contribution of Kansas Agricultural Experiment Station.)

The effect of three 2,4-D formulations on field bindweed seedlings when applied at two rates and two seasons of the year. Russ, O. G. and J. W. Zahnley. Seedling plants were marked with banbox canes in the spring of 1950. Duplicate square rod plots were treated with 1/3 and 2/3 pounds of acid per acre of the ester and amine formulations of 2,4-D and 1/3 pound of acid per acre of a low volatile ester in the fall of 1950 and the spring of 1951. There was an average of 46% survival of those plants receiving the treatment in the spring and only 15% survival of those receiving the treatment in the fall. Complete control was achieved only by 2/3 pound of ester applied in the fall. The amine and low volatile ester at the 1/3 pound rate appeared to be as effective as the ester, but all formulations at this rate failed to give complete control. (Contribution of Kansas Agricultural Experiment Station.)

Project 1. Use of herbicides in Control of Perennial Herbaceous Weeds

Hoary cress, Russian knapweed, toadflax,

and all other perennial herbaceous weeds

Robert T. Coupland

Summary

Twenty abstracts were received concerning these weeds. These, together with fragmental information obtained in response to a questionnaire, provide a basis for several general observations.

Hoary cress. Three cooperators (all in Saskatchewan) reported this weed to be semi-tolerant to 2,4-D in the pre-flowering stages, while three other workers (from Western Canada) reported it to be sensitive. One worker reported that it is tolerant in the flowering and full-growth stages. One report of the use of sodium chlorate indicates that it is sensitive at all stages to rates of 200 lb. per acre. Evidence of translocation into the vertical roots to a depth of 6 to 8 inches was given by one worker who suggested that translocation into the horizontal roots is probably more difficult.

Russian knapweed. Four workers report this species to be tolerant or semi-tolerant of 2,4-D. Sodium chlorate and polybor-chlorate, at 5 lb. and 16 lb. per square rod, respectively, were reported to eliminate this weed.

Toadflax. Numerous chemicals have been used in attempts to eradicate this species. Among those reported (with the maximum rate of application used) are the following: 2,4-D (4 lb. per acre), 2,4-D and sodium chlorate mixture (2 lb. and 12 lb., respectively, per acre), CMU (100 lb. per acre), sodium chlorate (8 lb. per square rod), polybor - chlorate (8 lb. per square rod), borascu (16 lb. per square rod), maleic hydrazide (24 lb. per acre), dinitro (10 gal. per acre), TCA (100 lb. per acre), and IPC (8 lb. per acre). Apparent killing was reported only from CMU at 80 to 100 lb. per acre, sodium chlorate at 4 lb. or more per square rod, polybor-chlorate at 8 lb. per square rod, and 10 gallons of dinitro per acre in diesel oil. Other treatments killed top growth or retarded seed production or top growth, but resulted in regrowth by fall.

Classification of 40 herbaceous perennials is presented in tabular form following the abstracts. This is compiled from the reports of 24 cooperators who answered the questionnaire (200 circulated). As in previous year, four classes of response were employed as follows:

I. (Very Sensitive) — Any perennial plant that is killed at indicated stages of growth with optimum application of an herbicide.

II. (Sensitive) — Any perennial plant that is controlled by an optimum application of an herbicide at indicated stages of growth and is killed by repeated treatments.

III. (Semi-tolerant) — Any perennial plant that is controlled by an optimum application of an herbicide at indicated stages of growth but is usually not killed by repeated applications.

IV. (Tolerant) — Any perennial plant that is not controlled by applications of an herbicide at indicated stages of growth and is not killed by repeated treatments.

Abstracts of Results of Cooperators

Burnet

The effect of 2,4-D and 2,4,5-T on Burnet (Sanguisorba minor). Maxwell, C. C. Burnet has become a problem in permanent meadows and pastures in parts of Ontario. Treatments were applied to half square rod plots on 31st of July, 1951, using the butyl ester of 2,4-D at 1000 and 2000 ppm and 2,4,5-T at 1000 and 2000 ppm. Enough of the spray solution was applied to thoroughly wet all foliage. By the 15th of September butyl ester at 1000 ppm reduced the burnet population by 10%, at 2000 ppm the reduction was 60%. All burnet plants appeared to be dead on the plots treated with 1000 ppm and 2000 ppm 2,4,5-T. On the 10th of September 10' x 20' plots were treated with the butyl ester of 2,4-D at 16 oz./acre, brushkill (50% 2,4-D/50% 2,4,5-T) at 8, 16, and 24 oz., and 2,4,5-T at 8, 16, and 24 oz. per acre. The equivalent of 20 gallons/acre of each mixture was applied to each plot. By the 1st of November the butyl ester had had no effect. Brushkill (a) at 8 oz./acre had had only slight effect, (b) at 16 oz./acre had reduced the plant population by 75% and (c) at 24 oz./acre had produced 95% control. 2,4,5-T at 8 oz./ acre had had no effect, at 16 oz./acre had reduced the population by 30%, and at 24 oz. had reduced the population by 95%. (Contribution of the Department of Botany, Ontario Agricultural College, Guelph, Ont.)

Cress, Hoary

Effect of 2,4-D on hoary cress. McCurdy, E. V. Work was started on a well established patch of hoary cress in 1950. Two applications of an ester at approximately 2 pounds to the acre were made during the season. Top growth was completely destroyed and after the last application no further regrowth was noted in the fall. In the spring of 1951 regrowth was quite strong, particularly near the edges of the plot. All plants were treated with an ester at 2 pounds to the acre in June, again in July, and a few plants which had made regrowth were given a third application in August. At present (October 1951) only a few shoots can be noted and these are making a very slow growth. With the favourable moisture conditions growth of most weeds has been rapid this fall so this indicates that hoary cress has been severely set back. On another part of the Farm, hoary cress was almost eradicated by heavy applications of an ester during two consecutive seasons. (Contribution of the Dominion Experimental Farm, Indian Head, Sask.)

Effect of various systemic herbicides on hoary cress, 1951. Pavlychenko, T. K. Replicated square-rod plots in an established stand of hoary cress (Lepidium draba) were treated at the flowering stage on July 9th with 1 and 6 lbs./a. rates of 2,4-D esters (Weedone LV4, Weedone Concentrate 48 and ACF649) and amine of 2,4-D (designated as ACF127). The soil was clay loam and the population of hoary cress varied from 37 to 104 plants per square yard. RESULTS: On Sept. 5th there was only slight difference between the lower and higher rates. All foliage was dead and stems, particularly in the lower rates, showed some green yet appeared to be lifeless. There was no regrowth at this time on any of the treatments, but there were a few viable underground buds present on the 1 lb./a. rate of Weedone Concen-

trate 48, Weedone LV4 and MCP127. The bud development on the remainder of the treatments usually resulted in a knobby mass of proliferated tissue, down to depths ranging from just below the surface with MCP127 to 6 and 8 inches below the surface with the other chemicals. Below this depth, no bud development had yet occurred. The treatments which caused abnormal bud development also caused abnormalities on the vertical roots; they were soft and spongy and in some cases they were splitting open, indicating effective translocation. Translocation into the horizontal roots appeared to be more difficult, and only three treatments (Weedone LV4, 1 lb./a. and Weedone Concentrate 48 at both rates) showed some effect on them. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Reaction of hoary cress to 2,4-D esters applied at the flowering stage. 1951. Pavlychenko, T. K. On July 9th, plots 20 by 40 feet were laid out on a dense, established stand of hoary cress (Lepidium drabe) on clay loam soil. The treatments were made with 2,4-D esters (commercial Weedone Concentrate 48 and 2,4-D ester of 10 pct. acid content) applied at 1 and 6 lbs./a. rates. All plots were sprayed in 70 gals. of water per acre. RESULTS: On September 5th there were no outstanding differences between any of the treatments. Each treatment produced a complete top-kill, and there was a small amount of regrowth present in each plot. Upon examination of the new shoots, it was found that in all cases they arose from old roots which had no top shoots at the time of treatment. These roots, therefore, had entirely escaped the effects of the chemicals. Treated stems were dead 6 to 8 inches below the ground. Some buds were found below this depth but they all showed the effects of the chemical; they were "knobby" and proliferated. (Contribution of Agr. Div., American Chemical Paint Company, Saskatoon, Sask.).

Dandelion

Effect of herbicides on dandelion in alfalfa. Bolton, J. L. and R. T. Coupland. A 5-yr. old alfalfa field at Prince Albert, Sask. was treated with several herbicides at two stages, May 26 and June 12 when height of alfalfa averaged 11 and 15 in., respectively. Dandelion was in the rosette stage. 2,4-D and MCP were applied by a wheel-mounted, hand-powered sprayer, delivering 7.1 gal. per acre. Dinitros were applied by a knapsack sprayer in 75 gal. of water per acre. By July 13 damage to weeds (expressed in terms of reduction of green foliage below checks) was 75% or more from the following treatments: 8 oz. of 2,4-D amine, 2,4 and 8 oz. of 2,4-D (butyl ester), 15 oz. of MCP (sodium salt), 6,8 and 10 oz. of MCP (butyl ester) in the first stage; and 8 oz. of 2,4-D ester, 12 and 15 oz. of sodium salt and amine of MCP, 8 and 10 oz. of butyl ester of MCP, and 2.2, 4.5 and 9.0 qt. of DNOSBP (ammonium salt - Dow Selective) in the second stage. 35 to 70% damage was caused by the following: 9 and 12 oz. of MCP sodium salt, 6,9,12 and 15 oz. of MCP amine, 2 and 4 oz. of MCP ester, 4.5 and 9 qt. of DNOSBP in the first stage; and 4 and 8 oz. of 2,4-D amine, 4 oz. of 2,4-D ester, 9 oz. of MCP sodium salt, 3, 6, and 9 oz. of MCP amine, 4 and 6 oz. of MCP ester, 4 qt. of DNOC (sodium salt - Sinox) in the second stage. Damage was 30% or less from the following: 2 and 4 oz. of 2,4-D amine, 3 and 6 oz. of MCP sodium salt, 3 oz. of MCP amine, 2.2 qt. of DNOSBP, and 1, 2 and 4 qt. of DNOC in the first stage; and 2 oz. of 2,4-D amine, 2 oz. of 2,4-D ester, 3 and 6 oz. of MCP sodium salt, 2 oz. of MCP ester, 1 and 2 qts. of DNOC in the second stage. Recovery was sufficient by Sept. 20 so that no appreciable effect of any treatment was observable at that time. The effect on alfalfa was such that the most promising treatments of those tested for dandelion control in alfalfa for forage would be 3 oz. of MCP amine in the first stage and 2.2 to 4.5 qt. of DNOSBP and 4 qt. of DNOC in the second stage. For control in alfalfa seed fields 2.2 to 4.5 qt. of DNOSBP and 4 qt. of DNOC in

the second stage were most promising. (Contribution of the Department of Plant Ecology, University of Saskatchewan and the Dominion Forage Crops Laboratory, Saskatoon, Sask.)

Dock, curled, chicory and bladder campion

The effect of C.M.U. on curled dock, chicory and bladder campion. Knowles, Geo. C.M.U. was applied as a post emergence treatment at the rates of 20, 40 and 80 pounds per acre on curled dock, (Rumex crispus) chicory (Chicorium intybus) and bladder campion (Silene latifolia). All of these weeds were controlled at least 100 per cent by all three rates. It should be pointed out that the above treatments were on weeds grown in nursery plots. (Central Experimental Farm, Ottawa, Ontario.)

Garlic, wild

Effectiveness of repeated annual applications of 2,4-D in controlling wild garlic in permanent pasture. Freeman, J. F., J. R. Hansen and L. M. Josephson. Wild garlic in heavily grazed bluegrass pasture plots was sprayed with 2,4-D during early April of 1948, 1949, and 1950. Frequency of occurrence in fifty 1-square-foot quadrats per plot was determined in April 1951. The averages of duplicate treatments were: (1) none, 60%, (2) 2,4-D amine - 1 pound rate, 38%, (3) 2,4-D amine - 2 pound rate, 14%, (4) 2,4-D ester - 2 pound rate, 12%. Most of the white clover had disappeared and the stand and vigor of bluegrass had been reduced in the plots receiving 2,4-D at the 2-pound rate either in the ester or amine form. Injury was appreciably less severe where 2,4-D amine at the 1-pound rate was used. In an adjacent area, frequency of occurrence of wild garlic on a plot treated once with 2,4-D ester - 2-pound rate in early April 1950 and for the untreated plot alongside were 38% and 56%. In comparison 3 applications of 2,4-D ester - 2 pound rate in early November 1949, early April 1950, and early November 1950, the frequency was 24% and for the untreated portion 46%. The amine 2,4-D at same rates and same 3 application dates as for the ester was similar to the ester in effectiveness. (Kentucky Agricultural Experiment Station).

Response of Wild Garlic (Allium vineale) to treatments of 2,4-D, 2,4,5-T? maleic hydrazide, IFC, and TCA. Zalik, Saul, G. A. Cries, and O. C. Lee. Two, 4 and 8 pounds acid per acre of the isopropyl ester of 2,4-D and 2,4,5-T (each applied in water and in kerosene), 6, 12, and 24 pounds acid per acre of maleic hydrazide and of IFC, and 6, 12, and 36 pounds of TCA were applied to wild garlic plots on October 8, 1950 (garlic plants 2-8 inches to leaf tips), November 8, 1950 (2-12 inches), March 24, 1951 (very little apparent growth), April 24, 1951 (2-12 inches), and May 5, 1951 (2-20 inches). Except for the IFC treatments, which were almost ineffective, there was a progressive reduction in stand of wild garlic for each chemical as the rate of application increased. 2,4-D and 2,4,5-T gave effective control at both 4 and 8 pounds per acre, both in water and kerosene when applied October 8. However, in the November applications there was decidedly better control with kerosene. In the spring applications there was a gradual increase in effectiveness of 2,4-D and 2,4,5-T as the stage of growth of the garlic progressed. In most instances 2,4-D was superior to 2,4,5-T. Maleic hydrazide gave good control at all rates and dates except the 6 pound rate applied in November. Effective control of wild garlic was obtained by all rates of TCA for each of the first three dates, but not for the April and May applications. Observations of

regrowth made in the fall after plowing early in September indicated that the stand of wild garlic was less in plots where the stand had originally been reduced by treatment. The early fall and late spring applications of maleic hydrazide were particularly outstanding. (Contribution of the Department of Botany and Plant Pathology, Agricultural Experiment Station, Purdue University, Lafayette, Indiana.)

Horsetail, Field

Controlling field horsetail (Equisetum arvense L.) with 2,4-D. Wood, R. E. Trials which commenced in 1948 with this troublesome weed were continued during 1951, using several brands of ester of 2,4-D. Eight farmer-co-operators 40 miles west of Winnipeg made applications to cereal crops (spring wheat and oats), and on land being fallowed. Stands of horsetail were quite dense, treatment being made by field sprayers to one-eighth acre plots. On six farms, cereal crops, heavily infested, were treated during June when the horsetail was in the "sterile" stage, 4 to 6 inches in height, at the rate of 4, 8 and 12 oz. acid per acre. On three farms 8 and 16 oz. acid were applied at various stages while the land was in the process of being fallowed. Conclusions can be drawn only from the plots under crop, and are in line with results previously reported as follows: (1) 2,4-D, while killing above-ground growth, fails to eradicate this weed; (2) more effective control is obtained by using the maximum dosage the crop will tolerate of an ester of 2,4-D (8 to 12 oz. for cereals); (3) treatment should be timed to allow the maximum of sterile growth to emerge, while keeping within the safe period of application for the crop. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

Knapweed, Russian

Effectiveness of several heavy chemicals for control of Russian knapweed. Derscheid, Lyle A. Duplicate 9' x 13' plots were treated with borascu at rates of 15 and 30 lbs. per sq. rd., with conc. borascu at rates of 5, 10 and 15 lbs. with Polybor at rates of 4, 8 and 12 lbs., with polybor-chlorate at 4, 8 and 12 lbs., with sodium chlorate at 5 lbs., with sodium sulfamate at 2 and 4 lbs., with CMU (chloro-methyl-urea) at 10, 20, 40 and 80 lbs. per acre and with DCA-70 (sodium trichloroacetate) at 10, 20 and 40 lbs. per acre. Treatments were applied June 26, 1951 when weeds were budding and readings were made September 24. The 5 lb. rate of sodium chlorate and the 16 lb. rate of polybor-chlorate gave complete elimination, while the 12 lb. rate of polyborchlorate and 4 lb. rate of sodium sulfamate gave about 90% elimination. None of the other treatments gave satisfactory control. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station.)

Effect of herbicides on Russian knapweed. McCurdy, E. V. Work was started in the spring of 1951 to study methods of the eradication of a well established block of Russian knapweed growing in a field of brome grass. Some plots were ploughed and then cultivated as frequently as required to control top growth. The intention was to compare eradication by cultural methods with eradication by chemicals. Since breaking, the knapweed has made a very strong growth and although cultivated a number of times during the season, plant regrowth was still very rapid and strong this fall. The plants of Russian knapweed made a much more rapid growth when they did not have brome grass to compete with. The 1-2 pound rate of an ester of 2,4-D and 1/2 pound application of a combination of 2,4-D and 2,4,5-T were applied at different dates during the season. Top growth was slightly retarded and

distorted, but after a temporary setback this weed continued to grow. Some headway appeared to be made with the 1½ pounds of an ester of 2,4-D and a combination of 2,4-D and 2,4,5-T. The former gave a more rapid kill of the top growth. On some of the plots where three applications had been made during the season the plants were weaker and were making much less regrowth. As well, the brome was thickening at the expense of the weed. It appears from this season's work, that 2,4-D when applied at a heavy rate to Russian knapweed, when competing with a well established stand of grass, will do more to control this weed than can be accomplished by cultural methods alone. Three pounds of Atlacide killed the weed completely and new growth has not appeared to date. Half this rate of Atlacide in combination with 1½ pounds of 2,4-D also gave a complete kill. By fall the brome was making some regrowth in these plots. (Contribution of the Dominion Experimental Farm, Indian Head, Sask.).

Rocket, yellow

Value of 2,4-D, MCP and 2,4,5-T in controlling yellow rocket. Buchholtz, K. P. Yellow rocket is a serious perennial weed of hay fields and pastures. Since these fields are usually sown with legumes treatment of the infestations with 2,4-D has not been recommended. Yellow rocket maintains appreciable leaf growth over winter and treatment in the early spring before the legumes break dormancy would avoid legume injury if control could be obtained at this time. Plots in a mixed legume brome grass pasture, heavily infested with yellow rocket were treated with amine preparations of 2,4-D, MCP, and 2,4,5-T on April 27, 1951. Applications of 0.125, 0.50 and 1.0 lbs. per acre were made with each material using water equivalent to 20 gallons per acre. Plots were 6 by 12 feet in size with 4 replications. On the date of application the yellow rocket had started to develop a seed stalk but no flowers were evident. Some of the legumes had just started development. Indexes of yellow rocket growth and bloom were taken on May 11. Percentages of plants remaining were made on June 11. 2,4-D gave significantly better control of the weed than MCP or 2,4,5-T. Use of 1 lb. of 2,4-D reduced stands to less than 3 pct. The 1 lb. applications of all three materials reduced bloom to less than 5 pct. of the check. Legumes were noticeably retarded by the treatments but were not eliminated. An earlier date of application would probably have given equivalent control of the yellow rocket with less injury to the legumes. (Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.)

Sage, pasture

Effect of herbicides on pasture sage (Artemisia frigida). Friesen, H. A. and Harris, H. D. An infestation of pasture sage growing in an over-grazed pasture was treated with various herbicides on August 2, 1950. The isopropyl ester and the alkanolamine amine of 2,4-D and an ester of 2,4,5-T were applied with a knapsack sprayer at dosages of ½, 1, 1 and 2 pounds of acid equivalent per acre. Sodium TCA also was applied at dosages of 20, 40, 60, 80 and 100 pounds of acid equivalent per acre. Results: In 1950 each dosage of TCA killed the native grasses and turned the sage a very deep pink color within one week after treatment. There was no further growth of grass or sage before freeze-up. In the late fall of 1951, the sage had recovered completely but the grasses showed no signs of life throughout the remainder of the season. The ester of 2,4-D at dosages of ½, 1 and 2 pounds and the amine of 2,4-D at 1 and 2 pounds per acre discolored the sage and caused many of the leaves to wither and drop prior to freeze-up in 1950. By late June of 1951, each

of these treatments had reduced the stand of sage by 95 to 100 percent. Furthermore, the grasses, freed of the sage competition, were taller and more vigorous than the grasses on the untreated checks. The ester at ¼ pound and the amine at ½ and 1 pound of acid per acre resulted in reductions in the stand of sage of 80, 80 and 60 percent, respectively. 2,4,5-T was found to be considerably less effective than 2,4-D. This was evidenced by the observation that in 1951, 2,4,5-T at 2 pounds per acre had reduced the stand of sage by only 70 percent. (Contributed by the Dominion Experimental Station, Scott, Sask.).

Effect of various systemic herbicides on pasture sage. 1950-1951. Pavlychenko, T. K. Plots 10 x 100 ft. of pasture sage (Artemisia frigida) were treated in the bud stage in 1950, at 2 and 4 lbs./a., with esters of 2,4-D (ACF784, Weedone Concentrate 48, ACF649); amine of MCP (ACF954); mixtures of 2,4-D and 2,4,5-T (ACF926, Weedone Brush Killer 32); Acetanilide and amylamide of 2,4-D(ACF646, ACF675A) and low volatility ester of 2,4-D (Weedone LV4). All chemicals were sprayed in oil. The soil was a sandy loam and the pasture was badly overgrazed. Results taken in 1950 were reported in page 125 of the 1950 N.C.W.C.C. Research Report. RESULTS: All plots excepting those treated with ACF675A remained free of sage regrowth until the end of July 1951. Only grasses were present and steadily gaining in all effective treatments. On Sept. 7th 1951 all plots showed regrowth, coming mostly from the old crowns which were not completely killed. Very few seedling plants were found. The treatments which gave 20 pct. regrowth, or less, were the 2 and 4 lbs./a. rates of ACF784, 4 lbs./a. rates of B. K. 32, Weedone LV4, ACF954, and ACF926. Those giving 20 to 50 pct. regrowth late in the season of 1951 were: 2 and 4 lbs./a. rates of Weedone Concentrate 48 and ACF649, and the 2 lbs./a. rates of B. K. 32. Increases in the population of native grass were noted in all plots. The treatments of ACF675A gave regrowth varying from 50 to 100 pct. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.).

Toadflax

Effect of herbicides on toadflax in competition with grass. Carder, A. C. This trial was planned in a district subject to recurrent spring wash which precluded intensive cultivation for weed control. A continuous infestation of toadflax, Linaria vulgaris, was ploughed up and seeded to brome in the spring of 1950. Owing to abnormally droughty conditions in that year establishment of the grass was poor and thin stands obtained in 1951 when chemical control was initiated. The herbicides were applied when the toadflax was in the vulnerable or late-bud stage. They involved (1) butyl ester, (2) a compound of propylene glycol butyl ether esters, (3) a butoxy ethanol ester and (4) a mixture of a triethanolamine and sodium chlorate. The first three formulations were applied at 1 and 2 pounds 2,4-D acid per acre; while the mixture was applied so that 3, 6 and 12 pounds of the chlorate were received with, in every instance, 2 pounds of 2,4-D acid per acre. Plots were quadruplicated and randomized. Examination 6 weeks after treatment indicated the 2-pound rate of the butyl ester to have suppressed top-growth of toadflax 20 per cent, while the butyl ether and butoxy ethanol esters each suppressed it 20 per cent. The 1-pound application proved much less effective though the butyl ester again gave the best control. The amine-sodium chlorate treatments suppressed growth of toadflax to a hardly noticeable degree. Where the 2-pound rate of the butyl ester had been applied some killing of below-ground parts occurred and resprouting was checked. Moreover, in contrast to other treatments, no viable seeds were produced with the heavy dosage of this chemical. The brome showed no injury from any treatment. No extensive elimination of toadflax is expected prior to several treatments and the formation of a tight grass sward. (Contribution of Dominion Experimental Station,

Beaverlodge, Alberta.)

A comparison of the effects of chlorophenyl dimethylurea (C.M.U.), sodium chlorate, polybor chlorate, and Borascu on toadflax. Corns, W. G. Well-established roadside infestation of toad flax at Edmonton was divided into plots for duplicate treatments with C M U (2 and 4 oz. per 100 sq. ft.), sodium chlorate (1½ and 3 lb. per 100 sq. ft.), polybor chlorate (1½ and 3 lb. per 100 sq. ft.) and Borascu (3 and 6 lb. powder per 100 sq. ft.). All but Borascu were applied as spray in 150 gal. water per acre. Toadflax plants were budding at time of treatment, June 21. Ensuing weather was very wet. Within one week after treatment both rates of sodium chlorate and polybor chlorate had killed top growth of toadflax. Effects of C M U became apparent slowly, killing top growth within six weeks to two months after treatment. At end of season toad flax treated with 3 lb. polybor chlorate or 1½ lb. sodium chlorate per 100 sq. ft. appeared dead. Likewise both rates of C M U killed top growth but a small amount of weak re-growth was apparent in September. Borascu did not take effect during the period of observations. Further assessment will be required next spring. (Contribution Department of Plant Science, University of Alberta).

Effect of herbicides on toadflax (Linaria vulgaris). Friesen, H. A., Keys, C. H. and Harris, M. D. On May 25, 1951, sodium chlorate (Atlacide) at 1, 2 and 3 pounds per 100 sq. feet; Sodium TCA and CMU at 20, 40, 80 and 100 pounds per acre, polybor chlorate at 3 pounds per 100 sq. feet; Borascu at 6 pounds per 100 sq. feet; Maleic hydrazide at 24 pounds per acre; and Dow's contact weedkiller (dinitro) at 10 gallons per acre in diesel oil were applied to a very dense stand of toadflax (400 shoots per sq. yard) on land which had not been in crop since 1948. Atlacide and polybor chlorate resulted in complete top kills with only a few sickly plants on the 1 pound Atlacide treatment attempting recover in October. Borascu appeared to be very slow in entering the soil with the result that the kills of both the tops and roots were not uniform. Each dosage of CMU resulted in a slow but complete kill of the top growth. At the 20 and 40 pound dosage, some viable root material had survived. At the 80 and 100 pound dosage there was no sign of recovery. TCA at all dosages was very slow in acting. However, on October 9, the tops and 80 percent of the roots were dead on all plots except where the 20 pound dosage was used. The dinitro, with 60 gallons per acre of diesel oil as a carrier, completely killed the toadflax with no sign of regrowth by October. Maleic hydrazide delayed the weed, but did not otherwise affect it. On June 5, IPC at 4 and 8 pounds per acre was applied. The top kills were fair but 100 percent regrowth was observed in October. The contact dinitro at 2 gallons in 20 gallons of diesel oil per acre applied on August 2 was ineffective. (Contributed by the Dominion Experimental Station, Scott, Sask.).

The effect of repeated applications of 2,4-D on toadflax (Linaria vulgaris) on land seeded down to crested wheat grass. Friesen, H. A., Keys, C. H. and Harris, M. D. A two acre plot, heavily infested with toadflax was seeded down to crested wheat grass in the late fall of 1948. In early June of 1949, one portion was sprayed with the ester and another with amine of 2,4-D each at 3/8 pound of acid equivalent per acre. Only a temporary stunting of toadflax resulted. The portion treated with amine in 1949 was divided and sprayed with the amine at dosages of ½, ¾, 1 and 1½ pounds per acre in 1950. Similarly, the ester treated portion was re-treated with ester at the dosages given for amine. Although good top kills resulted, regrowth was so rapid and abundant that the plots were retreated with heavier dosages in July of 1950. Thus the previously treated amine plots were treated with the amine at 3 pounds, while those plots which had received ½, ¾, 1 and 1½ pounds of ester were retreated with ester at 1, 2, 3 and 4 pounds of acid per acre. The

3 and 4 pound rates were applied with 4 gallons of diesel oil per acre as the carrier instead of water. In October 1950, the plots treated with 3 pounds of amine and 3 and 4 pounds of ester per acre had 15 percent regrowth, while those treated with 1 and 2 pounds of ester had 85 percent regrowth. The treatments given in July 1950 were again applied in May 1951. In October 1951, the stand of toadflax in the patches had been reduced by 75 to 85 percent on each of the treated strips. Furthermore, crested wheat grass was becoming established in the toadflax patches. (Contributed by the Dominion Experimental Station, Scott, Sask.).

The effect of repeated applications of 2,4-D on toadflax (Linaria vulgaris) on cultivated land not in crop. Friesen, H. A., Keys, C. H. and Harris, H. B. In 1949 ester and amine formulations of 2,4-D were sprayed on toadflax in the bud-flowering stage at dosages of ¼, ½, 1, 2 and 3 pounds of acid equivalent per acre. Each of the treatments resulted in some 80 percent killing of the top growth, however the roots appeared to suffer little or no damage. Consequently, regrowth during the fall of 1949 and the spring of 1950 was so heavy that the treated strips were retreated in June of 1950 with the same dosages used in 1949. Excellent top growth kills were again noted, but by August 1950, regrowth appeared to be more abundant on the treated strips than it had been in the original stand. So heavy was the stand of toadflax that the treated and untreated strips of toadflax were one-way disced at a depth of 6 inches. Regrowth in October 1950 on the treated strips was nil while on the untreated strips it was 75 percent. Regrowth on the treated strips was light on May 25, 1951 when these strips were again treated. In early June the plots were sown to barley with a one-way disc. In October the number of patches of toadflax had been reduced by some 60 percent, the size of the patches had been reduced by some 80 percent and the stand of toadflax in the patches had been reduced by 90 percent. Although these results indicate that toadflax might be weakened and possibly eradicated by the repeated applications of 2,4-D, the method is costly and seemingly impractical. (Contributed by the Dominion Experimental Station, Scott, Sask.).

The effect of C.M.U. on toadflax. Knowles, Geo. C.M.U. was applied as a post-emergence treatment at the rates of 20, 40, and 80 pounds per acre on toadflax (Linaria vulgaris). This weed was completely controlled by all of the above three rates of C.M.U. It should be noted that the above treatments were applied on toadflax growing in a nursery plot. (Central Experimental Farm, Ottawa, Ontario).

Common Name	Scientific Name	Herbicide and application per acre	State or Province	Spring Growth	Bud	Bloom	Fall Growth
Avens, three-flowered	Geum triflorum	2,4-D 4 lb.	Man.	III			
Bedstraw northern	Galium boreale	2,4-D 4 lb.	Man.	III			
Bindweed, hedge		2,4-D E 1 lb.	Man.		I		
Blackberry, wild		2,4,5-T 1 lb.	B. C.	II	II		
Burnet	Sanguisorba minor	2,4-D/2,4,5-T 1½ lb. 2,4,5-T 1½ lb.	Ont. Ont.				I I
Buttercup, tall	Ranunculus acris	2,4-D 1 lb. MCP 1 to 1½ lb.	B. C. B. C.	II-III II			
Carrot	Daucus carota	2,4-D 1 lb.	B. C.	I			
Cherry, ground	Physalis subglabrata	CMU 20 lb.	Wisc.	II			
Chickweed, field mouse-ear	Cerastium arvense	2,4-D E 1 lb.	P.E.I.	II	II	II	IV
Cocklebur		2,4-D E 1 lb.	Man.		I-II		
Cress, hoary	Lepidium draba	2,4-D S 1½ lb. E 1 lb.	B. C.	II	II		
		$NaClO_3$ 400 lb.	B. C.	II	II	II	II
		2,4-D 2 to 4 lb.	Man.	II	II	II	II
		2,4-D E 2 lb.	Sask.	III	III		
		2,4-D A 1 lb.	Alta.	II			
		2,4-D/2,4,5-T 1 lb.	Sask.	III			
Cress, Western yellow	Radicula sylvestris	2,4-D E 1 lb.	B. C.	II	III	III	
Daisy, oxeye	Chrysanthemum leucanthemum	2,4-D E 1 lb.	P.E.I.	III	III	III	IV

Common Name	Scientific Name	Herbicide and application per acre	State or Province	Spring Growth	Bud	Bloom	Fall Growth
		2,4-D 1 lb.	B. C.	II			
Dandelion	Taraxacum officinale	2,4-D 1 lb.	B. C.	I-II			
		2,4-D E ½ to ¾ lb.	Alta.		II		
		2,4-D E 1 to 1½ lb.	Man.	I			
		CMU 20 to 100 lb.	Sask.		II-III		
		CMU 20 lb.	Wisc.	III			
		2,4-D E ½ lb.	P.E.I.	I	I	I	IV
Dandelion, fall	Leontodon autumnalis	2,4-D E 1 lb.	P.E.I.	I	I	II	IV
		2,4-D 1 lb.	B. C.	I			
Dock, curled	Rumex crispus	2,4-D 1 lb.	B. C.	II			
		2,4-D 1 to 2 lb.	B. C.	IV			
Geranium	Geranium carolinianum	2,4-D 4 lb.	Man.	III			
Goldenrod	Solidago sp.	2,4-D E 1 lb.	P.E.I.	II	II	II	IV
Grass, Johnson	Sorghum halepense	CMU 80 lb.	Miss.		I		
		CMU 20 to 40 lb.	Miss.		II		
		TCA 20 to 80 lb.	Miss.		II		
Gumweed	Grindelia, perennis	2,4-D 4 lb.	Man.	I			
		2,4-D E 1 lb.	Man.		I	I	
Hawkweed, orange	Hieracium aurantiacum	2,4-D E 1½ lb.	P.E.I.	II	I	II	IV
Horsetail, field	Equisetum arvense	2,4-D E ¾ to 1 lb.	Man.	III			
		2,4-D 1 lb.	B. C.	III			
		2,4-D E 1 to 1½ lb.	Man.	III	III	III	III
Knapweed, Russian	Centaurea repens	2,4-D E ½ to 1 lb.	Man.	III	III	III	IV
		2,4-D A 1 lb. E 1 lb.	Alta.	IV			
		2,4-D/2,4,5-T 1 lb.	Sask.	III			

Common Name	Scientific Name	Herbicide and application per acre	State or Province	Spring Growth	Bud	Bloom	Fall Growth
Knotweed	Polygonum sp.	2,4-D E 1½ lb.	Man.	IV	IV		
Lettuce, blue	Lactuca pulchella	2,4-D E ½ to 1 lb.	Man.	III	II	III	IV
		2,4-D E 2 lb.	B. C.		II	III	IV
Milkweed, whorled	Asclepias verticillata	CMU 70 lb.	Wisc.	I			
		TCA 80 lb.	Wisc.	IV			
Nettle, stinging	Urtica gracilis	2,4-D A ½ lb.	Wisc.	II			
		2,4,5-T A ½ lb.	Wisc.	II			
		MCP A ½ lb.	Wisc.	II			
Plantain, common	Plantago major	2,4-D E 3/8 lb.	P.E.I.	I	I	I	III
		2,4-D 1 lb.	B. C.	I			
		2,4-D 1 lb.	B. C.	II			
Plantain, English	P. lanceolata	2,4-D 1 lb.	B. C.	I			
		2,4-D 1 lb.	B. C.	II			
Puccoon, hoary	Lithospermum canescens	2,4-D 4 lb.	Man.	II			
Rocket, yellow	Barbarea vulgaris	2,4-D ½ lb.	B. C.	II			
Sage, pasture	Artemisia frigida	2,4-D E 1 to 2 lb. in fuel oil	Sask.	I			
		2,4-D 1 lb. in diesel oil	N. D.		IV		
		2,4-D E 1 lb.	N. D.			IV	
		2,4-D 4 lb.	Man.	II			
		2,4-D E ½ to 2 lb.	Sask.	II			
Sorrel, sheep	Rumex acetosella	2,4-D E ½ lb.	P.E.I.	III	III	III	IV
		2,4-D 1 lb.	B. C.	IV			
Spurge, flowering	Euphorbia corollata	TCA 40 lb.	Wisc.	IV			

Common Name	Scientific Name	Herbicide and Application per acre	State or Province	Spring Growth	Bud	Bloom	Fall Growth
Spurge, leafy	Euphorbia esula	2,4-D A 1 lb.					
		E 1 lb.	Alta.	IV			
		2,4-D E 1½ lb.	Man.		III	III	
		2,4-D 1 lb.	B. C.			III	
Sunflower	Helianthus sp.	2,4-D E 1 lb.	Man.	I	I		
Thistle, bull	Cirsium lanceolatum	2,4-D 4 lb.	Man.	II			
Thistle, Canada	Cirsium arvense	2,4-D E 1 lb.	Sask.		II	II	
		2,4-D 1 lb.	B. C.	II			
		2,4-D 4 lb.	Man.	III			
		2,4-D E 1½ lb.	Man.		II-III	II-III	
Thistle, perennial sow	Sonchus arvensis	2,4-D E 1 lb.	Sask.		II	II	
		2,4-D 4 lb.	Man.	III			
Toadflax	Linaria vulgaris	2,4-D E 2 lb.	Sask.	III	III		
		NaClO3 320 lb.	Alta.	II	II	I	I
		2,4-D A 1 lb.					
		E 1 lb.	Alta.	IV			
Wormwood, biennial		2,4-D E 1½ lb.	Man.	I-II			
Yarrow	Achillea millefolium	2,4-D E ½ lb.	P.E.I.	III	III	III	IV
		2,4-D 4 lb.	Man.	III			

PROJECT II. CONTROL OF ANNUAL, WINTER ANNUAL, AND BIENNIAL WEEDS

Annual and Winter Annual Weedy Grasses Project Summarizer: Deane W. Finnerty

Summary

Twenty-two abstracts were submitted reporting work on annual and winter annual weedy grasses. Nine abstracts reported results on foxtails, eight dealt with wild oats, seven reported on crabgrass, one gave results on Japanese chess, and one mentioned darnel. Several abstracts reported results on more than one grass species.

Wild oats: One investigator reported that maleic hydrazide at 10 to 20 lbs. per acre caused severe stunting when applied at the 8- to 10-inch stage. This material gave good control at 40 to 80 lbs. per acre. Sodium TCA applied at the same stage caused slight damage at 20 lbs., considerable stunting at 40 lbs., and gave good control at 80 lbs. IPC gave good control only at 80 lbs. per acre when applied at the 8- to 10-inch stage. Another report indicated excellent control of wild oats in the fall of 1950 at rates of 8, 15, and 30 lbs. per acre of Chloro IPC and 15 and 30 lbs. per acre emulsifiable IPC. Chloro IPC at 8 lbs. per acre showed evidence of being practical on peas, soybeans, barley, corn, and wheat with crop tolerance decreasing in the order given. However, 5, 10, and 15 lbs. per acre of both forms of IPC severely injured or killed crops of corn, barley, flax, and wheat in 1951 spring trials. Endothal (M.E. 3001) at 4 and 8 lbs. per acre or at 4 lbs. per acre, combined with either 5 lbs. sodium TCA, 4 lbs. IPC, or 4 lbs. E. H. 5722, gave good control of seedling wild oats, with the Endothal-E. H. 5722 combination showing most promise. Endothal-treated plants showed reduced root systems. Wild oats were 70 per cent killed with remaining plants 55 per cent reduced in vigor from 4 lbs. Endothal applied at tillering stage. Eight lbs. Endothal gave 90% control and 85% reduction in vigor of remaining plants. Similar trials on sugar beets showed tolerance to chemicals and rates showing effective control. Sodium TCA at 5 to 20 lbs. per acre applied preemergence reduced dry weight of wild oats from 29 to 52%.

Foxtails: Green foxtail seedlings treated with 10 lbs. per acre of maleic hydrazide were considerably stunted in one test. Twenty, forty, and eighty lbs. of maleic hydrazide gave good control, being comparable to the same rates of TCA and much better than equal rates of IPC. In another test sodium TCA at 16 lbs. per acre applied at the 7- to 8-leaf stage on foxtail was given a herbicidal rating of 970.

$$\text{Where Herbicidal Rating} = 1000 - \frac{(\text{per cent stand} \times \text{per cent vigor of remaining weeds})}{10}$$

Eight lbs. Endothal was rated 930, 2 lbs. Endothal plus 8 lbs. sodium TCA was rated 885, 16 lbs. calcium TCA rated 850, and 8 lbs. sodium TCA was rated at 840. Later plantings of sugar beets indicated tolerance to rates of TCA or Endothal which controlled foxtail. Five, 10, and 15 lbs. per acre of sodium TCA at the cotyledonary stage of flax eliminated foxtail without injury to the crop. Endothal at 4 and 8 lbs. gave satisfactory control but reduced flax 30% at 4 lbs. and eliminated it at 8 lbs. One investigator reported 20 lbs. sodium TCA eliminated or severely reduced green foxtail, hog millet, and Siberian millet. Of thirteen herbicides tested at one location, the following appeared most effective, in decreasing order: CMU, Endothal, TCA, Chloro IPC, and maleic hydrazide. Four lbs. CMU or 8 lbs. Endothal reduced foxtail 95% or more when applied at seedling stage. Sodium TCA at 8 lbs. reduced stands 74%. Foxtail seedlings were controlled in flax (B 5128) with 5 to 10 lbs. sodium TCA or 5 1/2 to 11 lbs. calcium TCA without injury to flax. Tillage, especially plowing, was more effective than chemicals in controlling weeds in oat stubble. Three pts. Sinox General with 3 gal. No. 2 Range oil, 25 lbs. sodium TCA, and 1 lb. 2,4-D amine combined killed broadleaved weeds but did not satisfactorily prevent seed production by Setaria spp.

Crabgrass: Technical chlordane at 5 and 10 lbs. per acre added to kerosene-type oils killed crabgrass in 4 days. In greenhouse tests 15, 20, and 25 lbs. chlordane per acre prevented crabgrass emergence. Lawn grass seed germination was reduced 30 to 50%. PMA at 5 pts. per acre, 8 lbs. KOCN, and 1 lb. sodium arsenite applied twice in 100 gal. water per acre gave 85, 75, and 52% control, respectively. One application of Stoddard Solvent at 40 and 60 gal. per acre, and two applications each of S 2470 at 100 cc. per one gallon water per 100 sq. ft., and S 1840 (monoaminoboronium fluoride) gave 81, 91, 66, and 85% control respectively. Another test reported crabgrass control with 5 lbs. dichloral urea applied preemergence. An amine salt of MCP did not control crabgrass at 4 lbs. per acre but killed white clover 100% with severe injury at 2 lbs. One worker reported excellent results with S 1998 during a three-year period, with variable results from PMA. Ten pounds KOCN gave 90% crabgrass control when applied at the two-leaf stage. In a test with various shale oil and petroleum fractions, shale oil (gas oil) at 60 gal. per acre gave 96% crabgrass kill with 25% damage to bluegrass, petroleum (kerosene) at 120 gal. per acre gave 100% crabgrass control with 20% damage to bluegrass. One report listed PMA, Dow Premerge, and kerosene as most promising of 14 chemicals tested.

Japanese chess and darnel: Sodium TCA at 5, 10, 15, and 20 lbs. per acre gave the following dry weight reductions of darnel: 29, 51, 55, and 52%, respectively. The same rates on Japanese chess caused dry weight reductions of 47, 75, 72, and 95%. Three pounds of 2,4-D acid reduced dry weight of Japanese chess 52%; two pounds per acre 2,4-D acetanalide caused 45% reduction in dry weight of chess.

Abstracts of Cooperators

Control of crabgrass seedlings in established bluegrass lawn with shale oil and petroleum fractions. Bohmont, D. W. and Klingman, D. L. Replicated plots were established in bluegrass lawn heavily infested with crabgrass seedlings at Lincoln, Nebraska. Shale oil fractions of naphtha and gas-oil, at volumes ranging from 20 to 80 gal/acre and Stoddard solvent and petroleum kerosene ranging in volumes from 80 to 140 gal/acre were applied undiluted on June 27, 1951, to crabgrass seedlings possessing 3-4 leaves. Moisture was very good, humidity relatively high and a temperature of 98°F. Initial foliage damage was noted and counts taken 30 days after treatment. All shale oil treatments caused initial foliage injury to bluegrass ranging from 30 to 90 percent. Bluegrass recovered completely on all except the 60 and 80 gal/acre treatments. Petroleum fractions produced only slight initial injury to the bluegrass; however, 30 days later the 120 and 140 gal kerosene treatment still showed bluegrass injury of 10 to 20 percent. In all treatments the crabgrass suffered more damage than the bluegrass. The most effective shale oil treatment for killing crabgrass was found to be the 60 gal/acre gas-oil which killed 96 percent and damaged the bluegrass 25 percent. The most effective petroleum treatment was 120 gal/acre kerosene which killed 100 percent and damaged the bluegrass 20 percent. Lesser volumes of the oils produced no final bluegrass damage, however, on these treatments only 72 percent or less of the crabgrass was killed. Wyo. Agr. Exp. Sta., Laramie, Wyo., and Weed Division, BPIS&AE, Lincoln, Nebr.

Effectiveness of 13 herbicides on foxtail seedlings. Buchholtz, K. P. A uniform stand of annual grass, chiefly Setaria spp., was treated on June 6 with 2, 4 and 8 lbs. applications of the sodium salt of TCA, calcium salt of TCA, emulsifiable IPC in oil, emulsifiable CIPC in oil, polychloro arylalkyl carbonate (Goodrite PEC), dichloral urea (E.H. 2), M.H., endothal, N-2-chlorophenol-phthalamic acid (a), and N-1-naphtyl-phthalamic acid (b). Potassium cyanate was applied at 4, 8 and 16 lbs. per acre and PMA and 3-p-chlorophenol-1-1-dimethyl urea (CMU) at 1, 2 and 4 lbs. per acre. Applications were made when the grass was from 2 to 3 inches high using water equivalent to 40 gallons per acre. Four replications were used.

Quadrats of 4 square feet were harvested from each plot on July 12 and 13 and dry weights obtained. Injury indexes were taken on June 14. On this date CMU at 2 and 4 lbs., PMA at 4 lbs. and endothal at 2, 4, and 8 lbs. had given 80 pct. or greater reduction in leaf growth. PEC at 8 lbs. and potassium cyanate at 16 lbs. gave approximately 50 pct. reductions in leaf growth. Other treatments were less effective or gave insignificant reductions. E.H.2, IPC, PEC, (a), and (b) caused no significant reductions in grass yield when compared to check when harvested on July 13. Endothal and CMU at 2 lbs. severely reduced grass growth while higher rates reduced yields to 5 pct. or less of check. PMA at 4 lbs. and CIPC and MH at 8 lbs. reduced grass growth to about 40 pct. of check. Potassium cyanate caused a reduction of 25 pct. at 16 lbs. The 8 lb. application of TCA as either sodium or calcium salt reduced grass growth to approximately 26 pct. of check. The most toxic grass herbicides appeared to be CMU and endothal, followed by TCA, CIPC and MH. Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisc.

Effect of IPC on weedy grasses. Coupland, R. T. IPC was applied to duplicated rod-row plots of wild oats (Avena fatua) and green foxtail (Setaria viridis) on June 20th when the respective heights of the weeds were 8 to 10 inches and 3 to 4 inches, respectively. Rates of treatment were 0, 2.5, 5, 10, 20, 40 and 80 lb. per acre in 75 gallons of water. No effect was observable from the rates below 20 lb. per acre and only slight effect was noted from higher rates, the 80-lb. rate on wild oats causing the most damage. Damage to these weeds was greater from TCA and maleic hydrazide at the same rates. (Contribution from the Department of Plant Ecology, University of Saskatchewan, Saskatoon.)

Effect of maleic hydrazide on grassy weeds. Coupland, R. T. Maleic hydrazide was applied to duplicated rod-row plots of wild oats (Avena fatua) and green foxtail (Setaria viridis) sown on May 23rd. Treatment was carried out on June 29th when wild oats were 8 to 10 in. in height and green foxtail was 3 to 4 in. Rates of treatment were 0, 2.5, 5. 10, 20, 40 and 80 lb. per acre of the active ingredient dissolved in 75 gallons of water. Maleic hydrazide gave good control of wild oats at 40 and 80 lb. per acre and caused severe stunting at 10 and 20 lb. No effect was observed from the 2.5-lb. treatment and only slight effect from the 5-lb. treatment. Control of green foxtail was greater, this weed being well-controlled by the 20-, 40- and 80-lb. rates. 10 lb. resulted in considerable stunting, 5 lb. in slight stunting, and 2.5 lb. caused no observable damage. Control of wild oats was better than from comparable rates of TCA and IPC. Control of green foxtail was comparable to that caused by TCA and much better than with IPC. (Contribution of the Department of Plant Ecology, University of Saskatchewan, Saskatoon.)

Effect of trichloroacetate on grassy weeds. Coupland, R. T. TCA (sodium salt) was applied to duplicated rod-row plots of wild oats (Avena fatua) and green foxtail (Setaria viridis) on June 29 when heights of the grasses were 8 to 10 inches and 3 to 4 inches, respectively. Rates of treatment were 0, 2.5, 5, 10, 20, 40 and 80 lb. acid equivalent per acre in 75 gallons of water. 10-, 20-, 40- and 80-lb. rates gave good control of green foxtail and 80 lb. gave good control of wild oats. 40 lb. on wild oats and 5 lb. on green foxtail caused considerable stunting. 20 lb. caused slight damage to wild oats. 2.5, to 10 lb. on wild oats and 2.5 lb. on green foxtail caused no observable damage. TCA was more effective on both weeds than was IPC but less effective on wild oats than was maleic hydrazide. Effect on green foxtail was similar to that of maleic hydrazide. (Contribution of Department of Plant Ecology, University of Saskatchewan, Saskatoon.)

Effect of preplanting treatments with IPC on wild oats in field crops. Dunham, R. S., R. G. Robinson and A. F. Wiese. In a screening test of 20 chemicals in 1950, an emulsifiable form of IPC (LFN 644) when raked into the soil as a preplanting treatment at 12 and 20 pounds of IPC per acre was the only one that selectively killed wild oats in barley. A second trial with both the emulsifiable and

chloro forms of IPC was carried out in the fall of 1950. Rates of 8, 15, and 30 lbs. of the chloro form and 15 and 30 lbs. of the emulsifiable IPC were harrowed into the soil before planting wild oats, field peas, soybeans, barley, corn, wheat, flax, and oats. Wild oats were practically eliminated by all treatments. Crop tolerance decreased as follows: peas, soybeans, barley, corn, wheat, flax, and oats. At 8 lbs. of chloro IPC, injury to peas, soybeans, barley, corn and wheat was light enough to indicate the treatment had practical value. Both experiments comprised replicated field plots of one square rod each. In the spring of 1951, similar trials were carried out on plots large enough for field machinery. Both the emulsifiable and chloro forms were used at 5, 10, and 15 lbs. per acre. Test crops were corn, barley, flax, and wheat. Wild oats had been sown one week before and again at the time of sowing the crops. All crops were killed or severely injured. In the comparisons of the chloro with the emulsifiable form, the chloro IPC was slightly more injurious. (Contribution from the Division of Agronomy and Plant Genetics, University of Minn., St. Paul, Minn. Paper No. 2758, Jour. Series, Minn. Agr. Exp. Station).

Control of annual weeds by tillage, fertilizers, and herbicides after oat harvest. Dunham, R. S. and R. G. Robinson. This study compared tillage methods and herbicides for killing annual weeds following oat harvest and tillage methods and fertilizers for stimulating fall germination of weed seeds. All treatments were made a week after harvest and included (1) field cultivator, (2) field cultivator plus disk, (3) moldboard plow, (4) moldboard plow plus spike-tooth harrow, (5) same as 4 plus 24 lbs. of oats per acre drilled, (6) same as 4 plus 6 tons of manure per acre, (7) same as 4 plus 250 lbs. of 4-24-12 per acre. Herbicides were applied to the undisturbed stubble and included (1) Sinox General at 1 pint per acre plus TCA at 8.8, 13.2, and 22 lbs. per acre, (2) Sinox General at 3 pints plus 3 gals. of No. 2 Range oil, (3) 2,4-D amine at 1 lb. per acre plus TCA at 8.8, 13.2, and 22 lbs. per acre, (4) No. 2 Range oil at 3 gals per acre. Rates of 2,4-D and TCA are on the basis of acid equivalents and were applied in 40 gallons per acre. All tillage operations that included plowing were more effective in killing weeds than surface cultivation. The field cultivator plus disk was almost as effective as plowing and more effective than the field cultivator alone. None of the herbicides was as effective as tillage. Sinox General plus oil and TCA at 25 lbs. plus 2,4-D killed broadleaf weeds but did not satisfactorily prevent seed production by the Setaria spp. Volunteer oats on the surface cultivated plots and drilled oats on the plowing provided satisfactory cover to prevent wind erosion. Harrowing after plowing resulted in better stands of volunteer oats than plowing only. For stimulating weed seed germination, surface tillage was greatly inferior to plowing. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2759, Sci. Journal Series, Minn. Agr. Exp. Station).

Chemical control of crabgrass in a bluegrass lawn. Finnerty, D. W. PMA, Dow Pronergo, and kerosene appeared most promising of 14 chemicals tested for crabgrass control. Three applications at two-week intervals, beginning June 15, gave the following results: 10 pts. 10 per cent PMA in 100 gal. water per acre gave 86% crabgrass control with 10% injury to bluegrass, 5 pts. PMA resulted in 65% crabgrass kill and 5% bluegrass damage, 6 qts. Dow Pronergo in 100 gal. water per acre gave 70% crabgrass control and 5% bluegrass injury, 2 qts kerosene per square rod caused 85% crabgrass kill with 20% bluegrass injury. All treatments were applied to triplicated, randomized plots. Independent estimates were made by two individuals. Other promising treatments were: a late summer series of 12 qts. Dow Pronergo, gave 87% crabgrass kill and 11% bluegrass injury from three applications, 10 pts. PMA in a spring and fall series totaling six applications, resulted in 82% crabgrass control and 11% bluegrass injury, and a spring and fall series of 5 pts. PMA gave 67% crabgrass control with no apparent injury to bluegrass. A summer series of 8 lbs. KOCN per acre gave 65% crabgrass control with 6% injury to bluegrass. A sum-

mer series of 2 lbs. sodium arsenite gave 63% crabgrass control and 5% bluegrass injury. However, both KOCN and sodium arsenite gave variable results at most rates and dates of treatment. (Contributed by Nebraska Agricultural Experiment Station, Lincoln, Nebraska.)

Use of chlordane as an aid to the control of crabgrass by oil sprays. Grigsby, Buford H. Technical chlordane, at rates equivalent to 5 and 10 lbs. per acre, was applied in a number of oils of the kerosene type on crabgrass in lawn grasses. The combination caused a complete killing of crabgrass in 4 days time. Broad leaved weeds were defoliated but perennial species made regrowth. Chickweed, in bent grass turf, was killed without any serious injury to the bent grass. In greenhouse tests, 15,20 and 25 lbs. chlordane prevented crabgrass emergence in the treated soil. Lawn grass seed germination was reduced by 30 to 50 percent. The addition of chlordane to oil for the control of crabgrass increases the speed of kill, may inhibit further seed germination and at the rates used would also be effective for the control of certain turf insects. (Contribution from the Michigan Agricultural Experiment Station and Weed Investigations Div. B.P.I.S.&A.E.)

Pre-emergence control of annual grasses in sugar beets. Kratochvil, D. E. and Helgeson, E. A. Nine chemicals were applied pre-emergence to sugar beets. The chemicals were applied in 40 gallons of water per acre using two nozzle, oil cleaner sprayers, and treating the middle two rows of a four row plot 20 feet long. Cut worms and poor germination eliminated results of the beet response; however, counts and vigor estimations were made on the annual grasses of the area. Sodium TCA, Calcium TCA, or E. C. 3890 at 16 pounds per acre eliminated 80 per cent or more of the annual grasses leaving the remaining grass plants stunted. These plots remained nearly free of grasses for the entire growing season. The two TCA formulations gave excellent grass control at 8 pounds per acre. Endothal, Niagarthal-W (powder formulation of 3, 6, endoxohexahydro phthalate), E. H. 5722, and Chloro-IPC at 8 pounds per acre gave fair grass control. CMU (3-(p-chlorophenyl)-1, 1 dimethylurea) up to 2 pounds per acre showed no grass control. N-1-naphthyl phthalamic acid at 2 or 4 pounds per acre gave fair grass control. From this experiment TCA and E. C. 3890 appear to be the only chemicals showing promise for pre-emergence grass control. (Contributed by Weed Investigations, BPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station.)

Effect of several herbicides on wild oats (Avena fatua) at an early stage of growth. Kratochvil, D. E. and Helgeson, E. A. Wild Oats (Avena fatua) were drilled in rows seven inches apart on Fargo clay. Sodium TCA at 5, 10, or 15 pounds per acre, Chloro-IPC at 4, 8, or 16 pounds, Endothal (M. E. 3001) at 4 or 8 pounds, E.H. 5722 at 4 or 8 pounds, Ester of 2,4-D at 1 or 1 1/2 pounds, and Endothal at 4 pounds in combination with TCA-5 pounds, Chloro-IPC at 4 pounds, or E. H. 5722 at 4 pounds were applied in 40 gallons of water per acre to the oats at the seedling to 2-3 true leaf stage. Randomized duplicate 1/2 by 1 rod plots were treated. Stand counts and vigor estimations were made one month after treatment. These data were used to calculate a herbicidal rating for each chemical by L. M. Stahler's method of evaluating herbicides (1949 Proceedings of the N.C.W.C.C.). Sodium TCA, Chloro-IPC, E. H. 5722, and E. of 2,4-D did not show any appreciable herbicidal qualities on wild oats. Endothal at 4 pounds gave a herbicidal rating of 505; 8 pounds--920; Endothal plus Sodium TCA--640; Endothal plus Chloro-IPC--625; and Endothal plus E. H. 5722--910. Wild oats in all plots treated with Endothal or Endothal combinations were low in vigor with 50% or better reduction in stand. Endothal treated plants showed a root system of only one or two roots that were maintaining the plant in a stunted condition. (Contributed by Division of Weed Investigations, BPI, SAE, U.S.D.A., and North Dakota Agricultural Experiment Station.)

Response of foxtail (Setaria viridis and lutescens) infested flax to several herbicides. Kratochvil, D. E. and Helgeson, E. A. Square rod plots of foxtail infested flax were treated at the cotyledonary to 2 true leaf stage with 5, 10, or 15 pounds per acre of Sodium TCA, 4 or 8 pounds of Chloro-IPC, or 4 or 8 pounds of Endothal. The Setaria had 4 to 6 true leaves and were starting to tiller. Stand counts and estimation of vigor of the flax and weeds were made at harvest time. No injury to flax was observed at any rate of TCA, while virtually all Setaria was eliminated from the plots. Chloro-IPC injured the flax at both rates and did not give any appreciable control of Setaria. Endothal at 4 pounds reduced the flax to 30% of the check, at 8 pounds flax was eliminated. Setaria was satisfactorily controlled by Endothal at the two rates. (Contributed by Weed Investigations, BPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station).

Post-emergence control of annual grasses in sugar beets. Kratochvil, D. E. and Helgeson, E. A. Ten chemicals and three combinations of chemicals were applied post-emergence to heavily Setaria infested sugar beets. Cut worms and poor germination eliminated a high per cent of the sugar beets before results could be obtained. Annual grasses had 7 to 8 true leaves and 1 to 2 tillers. Chemicals applied in 40 gallons of water per acre to 3 replications of two rows 20 feet long. Stand counts and vigor estimations were made on the annual grasses. Sodium TCA at 8 or 16 lbs. per acre showed the best results giving a herbicidal rating of 840 and 970 out of a possible 1000 respectively (based on L. M. Stahler's method of calculating a Herbicidal Rating, N.C.W.C.C., 1949 Proceedings). Calcium TCA at 16 pounds per acre showed a rating of 850. The remaining grass plants in the TCA plots were stunted and of very little competition to beet plants in the plots. Endothal at 8 lbs. per acre showed a rating of 930, remaining grass plants in these plots were held to the soil by only 1 or 2 roots. This seems to be one of the characteristic injuries of Endothal to grass plants. The combination of Endothal 2 lbs. per acre plus sodium TCA at 8 per acre showed a rating of 885. A later planting of sugar beets indicated tolerance of rates of TCA, or Endothal at which grass control was obtained. Niagarathal-W (powder formulation of Endothal) at 2, 4, or 8 lbs. CMU (3-(p-chlorophenyl) -1, 1 dimethylurea) at 1/4, 1/2, 1, or 2 lbs. chloro-IPC at 2, 4, or 8 lbs, N-1 naphthalphthalamic acid at 1 pound, and E. H. No. 2 at 2, 4, or 8 pounds did not show any appreciable degree of grass control. (Contributed by Weed Investigations, BPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station.)

Effect of several herbicides on wild oats (Avena fatua) at the tillering stage of growth. Kratochvil, D. E. and Helgeson, E. A. Duplicate plots of wild oats (Avena fatua) were treated in the tillering stage of growth with TCA at 10, 15, or 20 pounds active ingredient per acre. Chloro-IPC at 8, 16, or 32 pounds, Endothal (M.E. 3001) at 2, 4, or 8 pounds, Ester of 2,4-D, at 1, or 1 1/2 lbs, E.C. 3890 at 8 pounds, and Endothal at 2 pounds plus E.H. 5722 at 2 pounds, Endothal at 4 pounds plus E.H. 5722 at 2 or 4 pounds, Endothal at 4 pounds plus TCA at 4 pounds, and Endothal at 2 pounds plus TCA at 4 pounds. Chemicals were applied in 40 gallons of water per acre on 1/2 rod by 1 rod plots of drilled wild oats. Stand counts and vigor estimations were made approximately one month after treatment. These data were used to calculate a herbicidal rating for each treatment by L. M. Stahler's method of evaluating herbicides (1949 Proceedings of the N.C.W.C.C.). Endothal or Endothal plus other chemicals were the only treatments showing promise. Endothal at 4 pounds per acre eliminated 70% of the wild oats and showed an estimated 45% vigor of the remaining plants. Endothal at 8 pounds eliminated 90% with 15% vigor of remaining plants. Endothal--E.H. 5722 combinations eliminated up to 80% of the wild oats with 35% vigor for the remaining plants. Similar trials on sugar beets indicate beet tolerance of all chemicals at rates which effectively controlled wild oats. (Contributed by Weed Investigations, BPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station.

Experiments with chemical control of crab grass in 1951. Lantz, H. L. Fifty plots, each 6 x 55 - 330 sq. ft. in size were laid out on a fairway of the Ames Golf and Country Club where small crab grass was exceedingly abundant. The season was wet, cool and two weeks late. The crab grass seedlings reached the two leaf stage about July 1 to 5. Materials used: Potassium cyanate, sodium arsenite, P.M.A.S, Tat-C-Lect 10% and 13%, Tat-C-Lect 4.75% powder. PMA #140. Replications 2. Rates of application in general were those recommended by the manufacturer. Method application. All plots sprayed with knap sack pressure sprayer. One gallon herbicide solution used per plot. Igepon used throughout as a spreader. Time of application - four begging dates of application. 1. July 9, 20 and 28. 2. July 20, 28. 3. August 10, 28. 4. August 29. Results. Potassium cyanate at 8, 12, 16 pounds per acre produced severe burning. The permanent turf grasses were not permanently injured. Early applications gave 89 percent kill. Midseason no better. Late season, seed stalk formation period, gave 95 percent kill. Phenyl mercuric acetate compounds. Crab grass early applications gave 95 percent control, midseason applications 90-92 percent. Late season 87 to 90 percent. Crab grass in treated plots turned yellow and died within a 14 to 21 day period. Sodium arsenite, EH2 and PMA #140 did not give satisfactory control. Department of Horticulture, Iowa State College.

Application of TCA for the control of annual grasses in flax in 1951 at three locations, one each in N. Dak., S. Dak., & Minn. MacDonald, W. P.; Zinter, C. C.; Slough, A. T. In early June 90% sodium TCA was applied at 5 and 10 lbs. of product per acre; 71% calcium TCA was applied at 5 1/2 & 11 lbs. of product per acre and 5 lbs. of sodium TCA was applied with 4 ounces of an alkanolamine 2,4-D, with three replications at each rate with plots randomized. The spray solution was applied at 10 gals. of water per acre. At time of treatment flax (B5128) was 3-5 in. in height and the Setaria 2-4 in. in height. No injury to flax was observed at either rate with sodium or calcium TCA at the three locations. Control of Setaria was considered satisfactory with both calcium and sodium TCA on July 12. At harvest time control was estimated as 90% or more in every case. Where the combination of TCA and 2,4-D were used, the control of Setaria and annual broadleaves was considered satisfactory and equal to a like quantity of either chemical. All sodium TCA plots at two locations gave some increase in yield, with an average of 0.97 bu. per acre. Results were negative at the third. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis, Minn.)

Application of Isopropyl-M-phenylcarbamate at 6 locations in Minnesota to control wild oats in 1951. MacDonald, W.P.; Zinter, C.C.; Slough, A.T. 50% IPC was applied at 2, 4, and 8 lbs. acid equiv. per acre at 3 locations as a pre-emergence spray for wild oats before flax was seeded. At 3 other locations it was applied on land seeded to barley but before emergence with wild oats just emerging. IPC applied with water at rate of 320 gals. per acre. All plots dragged and/or otherwise tilled immediately after spraying. In no case was there discernible control of wild oats or injury to crop. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis, Minn.)

Studies on the control of crabgrass in lawns. Nylund, R. E. Two experiments were carried on in 1951. In the first experiment, PMA at 5 pints of 10% PMA, potassium cyanate at 8 lbs. and sodium arsenite at 1 lb. in 100 gal. water per acre were compared. To each of the above herbicides was added a wetting agent (1 lb. Igepon AP-extra/100 gal. water). Each of the treatments was applied twice to eight 5' x 10' plots on an established bluegrass lawn. On the date of the first application (June 28) the soil was wet, grass 1" tall, crabgrass had 2-4 leaves, and the temperature was 67° F. On the date of the second application (July 5) the soil was moist (rain of over 1" on July 3), grass cut to 1", crabgrass had 2-5 leaves, and the temperature was 75° F. On the basis of crabgrass counts, PMA, potassium cyanate, and sodium arsenite killed 85, 75, and 52% of the crabgrass present respectively. Both potassium cyanate and sodium arsenite caused somewhat more discoloration of the bluegrass

than did PMA. However, one month after the last application no injury to bluegrass was visible on any of the plots. In the second experiment carried on at the same time and adjacent to the above, Stoddard Solvent at 40 and 60 gal. per acre, monoaminoboronium flouride (S1840M) at 17 1/2 lbs./200 gal. water/acre, and S2470 at 100 cc./1 gal. water/100 sq. ft. were compared in quadriplicated plots. The Stoddard Solvent and S2470 were applied once (June 26) while the S1840M was applied twice (June 28 and July 5). Percentages of crabgrass plants killed were 83, 91, 85, and 66% for the 40 gal. Stoddard Solvent, 60 gal. Stoddard Solvent, S1840M, and S2470, respectively. S1840M and S2470 caused the least amount of discoloration of bluegrass, and 60 gal. Stoddard Solvent the most. No permanent injury to the bluegrass was observed. (Paper No. 2733 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.)

Pre-emergence treatments of common darnel, Japanese chess and wild oats with different herbicides. 1951. Pavlychenko, T. K. Plots of common darnel (Lolium temulentum), Japanese chess (Bromus japonicus) and wild oats (Avena fatua) were established on silty loam soil at Saskatoon and were treated prior to emergence with TCA and KOCN at 5, 10, 15 and 20 lbs./a.; amine of MCP (Weedar MCP) at 1/2, 3/4, 1, 1 1/2 and 2 lbs./a.; acid of 2,4-D (ACP472) at 1, 2 and 3 lbs./a; acetanilide of 2,4-D (ACP646A), and a mixture of 2,4-D and 2,4,5-T (ACP926) at 1, 1 1/2 and 2 lbs./a. The cool and unusually rainy summer was particularly favorable to vigorous growth of the grasses. Under the growing conditions of 1951 all the grasses treated showed a considerably higher degree of recovery from the treatments than has been observed in previous years. The results expressed in terms of reduction in dry weight may be stated as follows: TCA at 5, 10, 15 and 20 lbs./a reduced the dry weight of common darnel by 32, 88, 96 and 75 pct.; of Japanese chess by 47, 75, 72 and 92, and of wild oats by 29, 51, 55 and 52 pct. respectively. The other chemicals gave agronomically unsatisfactory results, with the exception of ACP472, 3 lbs./a. and ACP646A 2 lbs./a. which caused reductions in dry weight of Japanese chess of 52 and 45 pct. respectively. (Contributed by Agr. Div., American Chemical Paint Company, Saskatoon, Sask.)

Pre-emergence treatments of hog millet, Siberian Millet and green foxtail with different herbicides. 1951. Pavlychenko, T. K. Plots of hog millet (Panicum miliaceum), Siberian millet (Panicum spp.) and green foxtail (Setaria viridis) were established on silty clay loam soil at Saskatoon and were treated prior to emergence with TCA and KOCN at 5, 10, 15 and 20 lbs./a.; amine of MCP (Weedar MCP) at 1/2, 3/4, 1, 1 1/2 and 2 lbs./a.; acid of 2,4-D (ACP472) at 1, 2 and 3 lbs./a.; acetanilide of 2,4-D (ACP646A) and a mixture of 2,4-D and 2,4,5-T (ACP926) at 1, 1 1/2 and 2 lbs./a. The cool and unusually rainy summer was particularly favorable to vigorous growth of the grasses. RESULTS: Under the growing conditions of 1951, all the grasses treated showed considerably higher degree of recovery from the treatments than has been observed in previous years. The results expressed in terms of reduction in dry weight may be stated as follows: excepting TCA, none of the chemicals used gave agronomically satisfactory control of the three grass species, irrespective of the rates used. This is true, also, of TCA at 5 lbs./a. rate which reduced the dry weight of green foxtail by 50 pct. but had no effect on the hog and Siberian millets. At 10 lbs./a. it eliminated Siberian millet, reduced the green foxtail by 68 and hog millet by 50 pct. At 15 lbs./a. it eliminated the two millets and reduced the green foxtail by 55 pct. At 20 lbs./a. it eliminated or reduced to agronomically insignificant proportions all the three grasses. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Control of crabgrass in lawns. Robinson, E. L. and Willard, C. J. Dichloral urea at 2 1/2, 5 and 7 1/2 lbs./A. and MCP as the triethanol amine salt at 1, 2, and 4 lb./A. were applied May 8, 1951, before germination of crabgrass. The 5 pound rate of dichloral urea gave complete control of crabgrass for the season, with only slight

discoloration of the bluegrass. 7 1/2 pounds discolored the grass severely, but it recovered later. 2 1/2 pounds gave about 50% control. MCP gave no control of crabgrass, or injury to bluegrass, but killed white clover 100% at 4 pounds, almost entirely at 2 pounds and somewhat at 1 pound. Ohio State University. (From report of undergraduate minor problem by the senior author.)

Chemicals for crab grass control in turf. Slife, F. W. For the past 3 years potassium cyanate, phenol mercuric acetate, and S1998 (a boronium fluoride compound) have been tested extensively at this Station for crab grass control. Potassium cyanate and S1998 have given excellent results in all cases when recommended rates have been used, but the results from PMAS have been variable. Potassium cyanate has caused some turf burning when temperatures were excessively high, but this injury has been only temporary and has disappeared within 3 to 4 days. Tests this year indicate that lower rates repeated may be just as effective and at the same time eliminate turf burning. Although 12 pounds of KOCN per acre have given excellent crab grass control, it has caused considerable burning of turf. Ten pounds of KOCN have given above 90 percent control of crab grass in the 2-leaf stage of growth with only leaf tip burning. In 1951, two other boronium fluoride compounds have been tested, S-2470 and S-1840-M. These appear to be very similar to S1998 in effectiveness against crab grass. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

PROJECT II. CONTROL OF ANNUAL, WINTER ANNUAL AND BIENNIAL WEEDS

Broad-leaved weeds. Investigation Leader - G. Knowles.

SUMMARY

Nine abstracts were received. The following are the chief problems dealt with in these abstracts: Annual weed control in alfalfa. The control of wild buckwheat and tartary buckwheat in grain crops, the control of wild cucumber in corn and the control of annual weeds by pre-emergence applications of C.M.U.

At Saskatoon, Saskatchewan, almost complete control of Russian pigweed, and lambs quarters was obtained from an application of 4 ounces of 2,4-D ester without injury to the alfalfa, higher rates of amine were also effective. Possibly due to adverse weather conditions a dinitro compound was less effective.

None of the many treatments tried have proved successful in the selective control of tartary buckwheat in a crop of wheat. Of all the treatments tried a low volatile ester appeared the most promising.

Very similar results were obtained when attempting the selective control of wild buckwheat in grain crops.

Excellent control of wild cucumber in corn is reported from Urbana, Illinois. The chemicals and rates used in this trial were 2,4-D isopropyl ester - ¼ pound per acre, 2,4,5-T polyethylene glycol butyl ether ester - ¼ pound acid per acre and 2,4,5-T amine - ½ pound acid per acre. All these chemicals except the 2,4-D ester gave excellent control of wild cucumber.

Bur cucumber (Sicyos angulatus) in corn was effectively controlled in corn by a bush killer at Kentucky Agricultural Experiment Station.

At Ottawa, Ontario, a pre-emergence application of 1 pound per acre of C.M.U. gave effective control of all annual weeds present for a period of one month. Rates of 2, and 3 pounds per acre gave good control of annual weeds for the entire growing season.

Annual Weed Control in Alfalfa. Bolton, J.L. and R.T. Coupland. Treatments on a field scale were applied to mature stands of alfalfa at Pas Trail, Sask. The rates used were 4 oz. of 2,4-D ester and 8 and 10 oz. per acre of 2,4-D amine. Applications were made May 4 when the alfalfa was 1 to 3 inches high, or very shortly after new growth appeared. The treated alfalfa showed some effects from the 2,4-D but recovered. At flowering time there was no apparent difference in maturity between treated and untreated strips. No difference in seed yield was apparent. Complete or practically complete control of Russian pigweed (Axyris amaranthoides) and lamb's quarters (Chenopodium album) was obtained from all treatments. (Contribution from the Department of Plant Ecology, University of Saskatchewan and the Dominion Forage Crops Laboratory, Saskatoon).

Annual Weed Control in Alfalfa. Bolton, J.L. and R.T. Coupland. Field treatments of DNOSBP (ammonium salt - Dow Selective Weed Killer) were applied on a mature stand of alfalfa at Pas Trail, Sask. Rates were 2.5 and 3.5 quarts per acre applied when the alfalfa was about 10 in. high on July 8. A light rain followed about 1 hour after application. Russian pigweed (Axyris amaranthoides) and lamb's quarters (Chenopodium album) wilted after treatment but recovered. The alfalfa was unaffected. It is thought that relatively low temperatures and rain accounted for the lack of control. (Contribution from the Department of Plant Ecology, University of Saskatchewan and Dominion Forage Crops Laboratory, Saskatoon).

The effect of herbicides on tartary buckwheat (Fagopyrum tataricum). Friesen, H.A. and Harris, M.D. The isopropyl ester of 2,4-D and low volatile ester (L.V.4) each at ¼ and ½ pound per acre. Dows selective (dinitro) at 3 and 4 pints per acre, potassium cyanate X1 at 8, 10 and 12 pounds per acre and monosodium cyanamide X5 at 40, 60 and 100 pounds per acre were applied to a heavy growth of tartary buckwheat in a field of Thatcher wheat. The wheat had 7 to 8 leaves and the buckwheat had 6 leaves at the time of treatment. The entire field had been sprayed with 3 ounces per acre of an isopropyl ester 2 weeks prior to these treatments. All treatments were applied with a knapsack sprayer using 80 gallons of water as a carrier. A detergent "Vel" was used with the X1 and X5 applications. The results from each treatment were mostly discouraging. The ester of 2,4-D and L.V.4 stunted, deformed and delayed the buckwheat but did not kill it. The weed control effected by the L.V.4 was sufficient to result in small yield increases. the dinitro product had no visible effect on the weed or the wheat. X1 and X5 at any of the dosages used did not effectively control or suppress the tartary buckwheat. X1 at 8, 10 and 12 pounds and X5 at 100 pounds per acre stunted and delayed the wheat and reduced its yield by almost 40 per cent. X5 at 40 and 60 pounds per acre delayed the crop but did not reduce the yield. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Effects of low volatility butoxy ethanol ester and volatile ethyl ester of 2,4-D on Tartary buckwheat. Corns, W.G. Tartary buckwheat planted in 100 square foot plots was treated with 2,4-D at two stages of plant growth: Stage 1, 3-4 leaves, June 1; Stage 2, early flowering, July 7. Rates of 6 or 12 oz. 2,4-D acid equivalent of low volatility butoxy ethanol ester (rates LV_1, LV_2) or of volatile ethyl ester (rates V_1 and V_2) were applied in triplicate in sprays of 60 gal. solution per acre at each stage of growth. Weather was cold and growth slow for a period after Stage 1 treatments. There was active growth and high temperatures at times of Stage 2 treatments. In addition to visual observations, plant counts were made in triplicate square foot quadrats in fixed positions in each plot (25-30 plants per square foot). Stage 1 material was counted June 1, June 15, July 21, and August 14. Stage 2 plots were assessed July 14 and August 14. Percentage reductions in numbers of plants based on initial and final counts were for Stage 1, LV_1:18%, LV_2:41%, V_1:8%, V_2:15%, Check 18%. Stage 2. LV_1:33%, LV_2:50%, V_1:23%, V_2:30%, Check 0%. No applications caused very severe stunting

of surviving buckwheat plants. While no treatment was very satisfactory, superiority of the low volatility formulation is indicated.
Contribution - Department of Plant Science, University of Alberta.

The effect of herbicides on wild buckwheat Polygonum convolvulus. Friesen, H.A. and Harris, M.D. Wild Buckwheat in Ajax oats was treated at two stages of growth vis: 1) 2 leaf stage and 2) just prior to vining. At the 2 leaf stage an isopropyl ester, an amine and a low volatile ester (L.V.4) were sprayed at rates of ¼ and ½ pound of acid equivalent per acre. Two selective dinitro products also were applied (4 pints of the herbicide in 4 gallons of water per acre). The amine and ester formulations killed 30 per cent of the buckwheat seedling and markedly depressed the survivors. The dinitros did not kill it or materially suppress its growth. The low volatile ester resulted in 75 per cent kills of Polygonum but seriously reduced the yield of oats. At stage 2, the above treatments were again applied. In addition pentachlorphenol PCP at 8, 16 and 24 pounds per acre, Xanthogen disulphide (Sulphasan) at 1 and 2 gallons per acre, potassium cyanate X1 at 8, 10 and 20 pounds per acre and monosodium cyanamide X5 at 40, 60 and 100 pounds per acre were applied. The amine and ester of 2,4-D and L.V.4 stunted the buckwheat but did not kill it. The L.V.4 suppressed the buckwheat sufficiently to result in a slight increase in yield. The dinitro damaged the oats, but not the buckwheat. Sulfasan injured the buckwheat and the crop, but did not kill the weed. PCP at 16 and 20 pounds gave complete kills of buckwheat, but resulted in crop damage. X1 and X5 gave 90 per cent buckwheat control, but reduced the crop yield by almost 50 per cent. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Control of wild cucumber with 2,4-D and 2,4,5-T. Slife, F.W. Wild cucumber is an extreme pest in river bottom areas of Illinois. It germinates after the last cultivation of corn and covers over the corn within 2 months, making harvest a difficult problem. It is highly resistant to 2,4-D, but 2,4,5-T has done an excellent job. This test was set up to test the effectiveness of several formulations of 2,4-D and 2,4,5-T. Chemicals and rates used in this trial were 2,4-D isopropyl ester - 1/4 pound acid per acre, 2,4-D-2,4,5-T polyethylene glycol butyl ether esters - 1/4 pound acid per acre, 2,4,5-T polyethlene glycol butyl ether ester - 1/4 pound per acre, 2,4,5-T isopropyl ester - 1/4 pound acid per acre, and 2,4,5-T amine - 1/2 pound acid per acre. All of these chemicals except the 2,4-D ester gave excellent control of wild cucumber. These chemicals were applied on August 25 with a high clearance sprayer delivering 20 gallons output per acre. There were some new plants developing from seed by October 15, therefore spraying in early September may be better from the standpoint of new plants developing. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois.)

Control of bur cucumber (Sicyos angulatus) in corn. Hansen, J.R. Bur cucumber begins germination in June and continues through the summer, growing extensively after corn is laid by and making mechanical harvesting extremely difficult. The weed is resistant to 2,4-D. On July 5, 1951 several herbicides were tested on the M.B. Rice farm in Daviess County, Kentucky, in a badly infested spot. Corn was sprayed previously with about 0.5 pound of 2,4-D amine and laid by with the second cultivation about July 1. On July 5 corn was 4 to 5 feet tall and herbicides were

applied between rows near the base of plants in a randomized replicated test. Materials included check ester 2,4-D, check low volatile ester 2,4,5-T, and the polypropylene glycol butyl ether esters of 2,4-D and 2,4,5-T in equal concentrations (brush killer) each at 0.5 and 1.0 pounds; maleic hydrazide at 2 and 4 pounds; and CMU at 0.75 and 1.25 pounds. Cucumbers had 1 to 3 foot runners but were not attached to the corn stalks. From observations 1 week later there appeared to be good control with 2,4,5-T and brush killer. Plants were dead or dying, but the kill appeared more complete with brush killer. The 0.5 pound rates were as good as the 1-pound rates. Other materials including 2,4-D had little or no effect at that time. Final observations on these materials was not possible since the field was re-sprayed with brush killer, 0.5 pounds per acre, with a high clearance sprayer and drop nozzles. Observations on October 2 indicated complete control by the commercial application, and corn yields averaged 91 bushels per acre in sample plots in both treated and untreated uninfested areas. (Kentucky Agricultural Experiment Station)

The effect of herbicides on annual weeds in wheat on summer-fallow. Friesen, H.A. and Harris, M.D. Water solutions of the butyl ester at dosages of 1/8, ¼ and ½ pound, the amine (2,4-D) and methoxone (amine) at ½ pound per acre were sprayed on wheat lightly infested with annual weeds. The chief weed species were Thlaspi arvense, Salsola pestifer, and Polygonum convolvulus. The sprays were applied at 6 day intervals beginning when the wheat was 2 inches tall. A total of 12 applications were made. During dates 3 to 7 inclusive the crop advanced from 6 inches in height to the boot stage and the weeds from the seedling to the bloom stage. Each treatment during this period resulted in near complete kills of the Thlaspi and each treatment, except methoxone and the ester at 1/8 pound, gave complete kills of Salsola. Polygonum was suppressed, but not killed by any of the treatments. None of these treatments adversely affected the crop. At dates 3, 4 and 7, the weed control resulted in increased yields. Dates 1 and 2 were not satisfactory because of the excessive crop damage which resulted. At dates 8 to 12, inclusive, the mature Thalspi and Polygonum were not affected by the herbicides, however, kills ranging as high as 80 per cent of Salsola were noted from the ester at dosages of ¼ and ½ pound and the amine (2,4-D) at ½ pound. Severe yield reductions resulted from each treatment made just prior to and at heading time, dates 9 and 10. Yields of wheat were not affected by the treatments at dates 11 and 12. (Contributed by the Dominion Experimental Station, Scott, Sask.)

The effect of C.M.U. on annual weeds. Knowles, G. All annual weeds present were effectively controlled by 2 and 3 pounds per acre rates of C.M.U. applied before emergence. A 1 pound rate per acre gave good control of all annual weeds for a period of about one month. Rates of less than one pound per acre did not give a satisfactory control. The annual weeds present were, purslane, lamb's quarters, red root pigweed, yellow foxtail, and barnyard grass. (Contributed by the Central Experimental Farm, Ottawa, Ontario.)

PROJECT II. CONTROL OF ANNUAL, WINTER ANNUAL AND BIENNIAL WEEDS

Classification of above weeds. Investigation Leader:- G. Knowles

Basis of Classification

I. (Very sensitive)	Any weed killed at indicated stages of growth with 4 ozs. or less of 2,4-D.
II. (Sensitive)	Any weed killed at indicated stage of growth with 5 to 8 ozs. of 2,4-D.
III. (Semi-tolerant)	Any weed severely affected but not killed at indicated stages of growth with from 5 to 8 ozs. of 2,4-D.
IV. (Tolerant)	Any weed not affected to any extent at indicated stages of growth with from 5 to 8 ozs. of 2,4-D.

USE OF ROMAN NUMERALS

For the sake of brevity the above Roman numerals are used in the accompanying tables to indicate the reaction of each weed at the stage when the treatment was applied. e.g. (I) Very sensitive, (II) Sensitive, (III) Semi-tolerant, (IV) Tolerant.

ABBREVIATIONS: A - amine; E - Ester; T - 2,4,5-T

CLASSIFICATION OF ANNUAL, WINTER ANNUAL AND BIENNIAL WEEDS

COMMON NAME	SCIENTIFIC NAME	FORMULATION USED	STATE OR PROVINCE	SEEDLING GROWTH	SHOOTING	BUD	BLOOM
Cinquefoil	Potentilla sp.	A.	Ohio	I	I	I	II
Catchfly, Night-flowering	Silene noctiflora	A.	Ohio	III	III	III	IV
Carpet weed	Molluga venticillate	E.	Kansas				IV
Cut leaved primrose	Enothera laciniata	E.	Kansas	I	I		
Lambs quarters	Chenopodium album	A.	Ohio	I	II	II	II
Lambs quarters	Chenopodium album	E.	Kansas	I	II		
Lambs quarters	Chenopodium album	A.	Kansas	II	II		
Mustard, wild	Brassica arvensis	A.	Ohio	I	I	I	I
Night shade, black	Solanum nigrum	A.	Ohio	III	III	III	IV
Pigweed, rough	Amaranthus retroflexus	A.	Ohio	II	II	II	III
Plantain, buckhorn	Plantago	A.	Ohio	I	III		
Purslande	Portulaca	E.	Kansas				IV
Ragweed, common	Ambrosia artimisiifolia	E.	Kansas	II	III	III	III
Smartweed	Polygonum persicaria	E.	Kansas		III	III	III
Velvet weed	Albutilon theophrasti	E.	Kansas	I	II	III	III
Wild buckwheat	Polygonum Convolsulus	E. & A.	Kansas				IV
Wild buckwheat	" "	E.L.V.	Sask.	III			
Tartary buckwheat	Fagopyrum tataricum	E.L.V.	Alta.	III			
White prickly poppy	Angemone intermedia	E.	Kansas		II		
Yellow foxtail	Setarua glauca	A.	Ohio	II	IV		

Project III. Control of Weeds in Field Crops

Spring Sown Grain

Lyle A. Derscheid

Summary

Previous years' results indicate that the greatest inhibitory effect of 2,4-D on small grains occurs during meristematic differentiation. These data also indicate that the growing period of barley can be divided into at least four developmental periods, each responding in a different way to treatment with 2,4-D. The four developmental periods are (1) a susceptible seedling period extending from shortly after emergence to the 5th-leaf-expanded stage (two seedling leaves have generally disappeared and this stage can easily be termed as 3-leaf stage), (2) a relatively tolerant period between the 5-leaf stage and the early boot stage, (3) a second susceptible period extending from boot stage to fully headed stage, and (4) a resistant post-heading period beginning when the grain is in milk or soft dough. Oats and wheat follow the same general pattern except that oats appears to be more susceptible during the 2nd period. Barley and wheat are most susceptible during the 1st period, followed in order by the 3rd, 2nd and 4th periods, and oats follows this pattern except that it is equally susceptible during periods 2 and 3. This year's data conform to the same general pattern.

During the first (seedling) period, vegetative differentiation is inhibited causing a decreased number of tillers, fewer heads and, normally, a reduced yield in addition to malformed vegetative plant parts. G. Friesen et al. and H. Friesen et al. reported a reduced yield of barley and wheat during this period. Olson et al. reported it on barley. These writers infer that the most serious damage was done at the 2- to 3-leaf stage. G. Friesen et al. and H. Friesen et al. reported leaf deformities of barley and oats respectively. Davidson reported a gradual decrease in oat yields from shortly after emergence to early shot blade together with deformed leaves prior to and including 3-leaf stage, less straw strength from 3-leaf to early shot blade, deformed panicles and uneven ripening between 2- and 4-leaf stage.

During the second period, which is relatively tolerant, the application of 2,4-D at the time of floral initiation causes a reduction in the number of seeds per head and a decreased yield in addition to an increased frequency of head abnormalities -- primarily a disarrangement of florets. The severity of the injury is proportional to the number of growing points undergoing floral initiation at the time of treatment. If 2,4-D is applied when many heads are being differentiated, serious yield reduction is possible. H. Friesen et al., reported that ¼ and ½ pound applications of 2,4-D did not cause reduced yield of barley or wheat, Olson et al. concurred on barley as did G. Friesen et al. and Pavlychenko on wheat. G. Friesen et al. damaged barley during the first part of this period and noted that spikes were being differentiated. However, G. Friesen et al. reported that "the most vulnerable stages in oats occur from about the 4- or 5-leaf stage to very early boot", and H. Friesen et al. stated that the "critical period (in oats) appeared to extend from the 7-leaf until just prior to early boot". H. Friesen et al. also reported that these results did not closely follow the observations of 1949 or 1950. Davidson also found that yields gradually decreased until the early shot blade stage. It is possible that cool moist growing conditions prevailed this year, resulting in slow differentiation. Any treatment applied during the 14-18 days in which floral initiation takes place, would injure some growing points. In a dryer, warmer year differentiation would be faster resulting in two periods of sharp yield reduction separated by a period of no floral initiation and no reduction in yield. G. Friesen et al. indicates that injury was obtained during a 15-18 day period.

In the third (heading) period, which is relatively susceptible, all of the effects of 2,4-D are not understood. It is possible that growth of main culms is stunted and vegetative growth of new tillers is produced at the expense of fruit growth, or that the development of embryo sac and/or gametes is inhibited. Regardless of the reaction affected the reduction in yield is associated with a decrease in seed number, an increased number of blasted florets and otherwise partially unfilled heads, frequent lodging and delayed maturity. G. Friesen et al. reported a decreased yield of barley by application of 2,4-D 4-14 days prior to heading -- a period beginning with another and stigma differentiation and continuing through the growth stages of the flowering parts. Olson et al. reported a decreased yield on barley plots treated 3-7 days prior to heading and reduced yield and lodging by treatments applied 3 days post-heading. H. Friesen et al. felt that the most susceptible stage in barley was when heads were emerging; they noted decreased yield, delayed maturity and reduced plant height. G. Friesen et al. noted a decreased yield of wheat 8 days prior to heading, while H. Friesen et al. observed sterility delayed maturity, reduced plant height and decreased yield 9-12 days prior to heading. G. Friesen et al. and H. Friesen et al. treated oats during this third period of growth. H. Friesen et al. reported a delay in maturity, but neither group obtained a decrease in yield.

During the fourth (post-heading) period, there is no differentiation of meristematic tissue and the application of 2,4-D does not ordinarily affect the yield. G. Friesen et al. and H. Friesen et al. treated barley, oats and wheat; Olson et al. treated barley and Davidson treated oats in this period. None of them reported any damage to yield.

In previous years Barbless and possibly Moore barley and Mindo oats have been more susceptible to 2,4-D than numerous other varieties. Clinton, Andrew, Anthony, Vanguard and Ajax oats have also shown indication of being more susceptible than some other varieties. This year Bridgeford and Dunham indicate that Feebar, Plains and Moore are slightly more susceptible than five other barley varieties, while G. Friesen et al. did not observe any differential responses among three oat or three wheat varieties. Davidson, likewise did not observe any differences among five oat varieties.

When the same rate of application was applied, H. Friesen et al. indicated that the ester form was more toxic to barley, while G. Friesen et al. and Davidson felt that the same was true on oats. Wood et al. indicated that an oil diluent caused a browning of the leaves of seedling oat plants, while water did not. This discoloration was temporary, however. Pavlychenko reported little difference in the relative toxicity of an alkyl ester, a low volatile ester and an amine of 2,4-D, or several other experimental chemicals when applied to wheat or spring rye.

The effects of several chemicals, other than 2,4-D, on small grain was reported by several groups of workers. Coupland reported 80 pound preemergence and 40 pound post-emergence applications of TCA caused injury to small grains and flax but that one-half of these rates did not. Robinson and Dunham, however, stated that residual effect of TCA caused damage to soybeans planted 1½ years later, to corn planted 8 months later, and to barley and wheat planted 6 or 7 months later, while oats and flax were not materially affected. Soybeans and wheat appeared to be the most susceptible crops followed in order by barley, corn, oats, and flax. Pavlychenko indicated the same sequence of relative tolerance of small grains treated preemergence with TCA. Five pounds prevented emergence of wheat, 10 pounds reduced dry weight of barley, 15 pounds prevented emergence of barley and 10-20 pounds reduced dry weight of oats.

Coupland stated that 20 pounds of MH or IPC caused severe damage to small grains and flax when applied to a seedling stage of growth. A 40 pound rate of each chemical caused severe damage if applied preemergence. When these rates were cut in half, there was no observable damage. MacDonald et al. did not injure barley or flax with 8 pound preemergence applications of IPC.

Le Tourneau and Heggeness reported that ½ pound of endothal and ¼ pound of activated endothal (containing ammonium sulfate) applied to wheat in the boot stage caused 20-25% reduction in stand and 10% reduction in height. Higher rates caused more damage.

Abstracts of Results of Cooperators

Barley

Response of barley varieties to 12 oz. of 2,4-D, amine. Bridford, R. C. and R. S. Dunham. Barbless, Mars, Kindred, Montcalm, Moore, Feebar, Plains, and Vantage were sprayed at 3 inch, full tiller, jointing, and boot stages at the West Central Experiment Station, Morris. All plots were replicated and kept weed-free by cultivation. Although varietal differences were small, Feebar, Plains, and Moore showed somewhat more susceptibility than the other varieties in a three year trial. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2753, Sci. Jour. Series, Minn. Agr. Exp. Station).

The effect of 2,4-D on Barley at different stages of growth. Friesen, George and Olson, P. J. In an experiment conducted in the greenhouse, Montcalm barley was sprayed with an isopropyl ester of 2,4-D at 32 stages of growth, beginning before emergence and continuing at 1 or 2 day intervals until the crop was well past heading. The rate of chemical applied was 12 ounces acid per acre. Six replicates were used in the test. A study was made of the development of the spike at each of the treatment dates. This was done by taking representative plants and dissecting the growing points from the stems. Photomicrographs of the growing point were made at each of the treatment stages. The results supported those usually obtained in the field in delineating two widely separated periods during which the crop was particularly susceptible to injury. The first was represented by early seedling stages when the plants were 1½ to 8 inches tall and had 3 leaves. On the basis of abnormalities produced this period could be subdivided into two phases, the first, up to the 5 inch stage being marked by leaf deformities; and the second (5 to 8 inch stage) producing only spike deformities. This period coincided with the production of leaf initials and early spike differentiation in the growing point. The second susceptible period occurred when the plants were in the boot stage, 4 to 14 days in advance of heading, which resulted in a high degree of sterility. This corresponds to a period beginning with anther and stigma differentiation and continuing through the growth stages of the flowering parts. The exact time at which pollen was shed was not determined, but as no sterility occurred 4 days before heading it can possibly be assumed that pollination had taken place at this stage. (Contrib. by the Division of Plant Science, The University of Manitoba, Winnipeg).

Differential response of three varieties of barley to treatment with 2,4-D. Friesen, Geo. and Olson, P. J. A butyl ester and an alkylamine were applied, each at 4 and 8 ounces acid equivalent per acre on two dates at Winnipeg, to Montcalm, O.A.C. 21 and Vantage barley. Applications were made in the form of a water spray using 60 gals. of water per acre. The first date of spraying was June 12 when all three varieties were about 9 inches tall and had 4 leaves. The second spraying date was June 29 for Vantage and O.A.C. 21, and July 3 for Montcalm. No significant reduction in yield took place at either date, therefore no differential variety response could be designated here. The averages for rates over both dates and all

varieties showed significant yield reductions under the 8 ounce rate. When comparing formulations no statistical difference could be shown. (Contribution from Division of Plant Science, The University of Manitoba.)

Reaction of barley to 2,4-D applied at different stages of growth. Friesen, H. A. and Harris, H. D. Plots of Titan barley were sprayed with the butyl ester at ¼ and ½ pound and a "mixed" amine at ½ pound of 2,4-D acid per acre. The treatments were made at 20 different stages of growth, beginning at emergence and continuing at 3 day intervals until the barley was in the soft dough stage. In 1949 and 1950, and again in 1951 there were two distinct periods during which barley was particularly susceptible to 2,4-D injury. The first was represented by the early seedling stages, i.e. from emergence until the plants were nearly 5 inches tall, stages 1 to 6. Each treatment during these stages reduced the yield, however, the yield reductions were statistically significant only at stages 1 to 4. Furthermore maturity was delayed by 3 days and almost all of the treated plants were deformed. The second occurred during the boot to the fully headed stage. Each treatment made during this period delayed ripening, reduced the average plant height, caused severe lodging and depressed the yield. The most susceptible time occurred at head emergence, stages 12 and 13, when maturity was delayed by 5 days, plant height was reduced by 6 inches and the yields were significantly reduced. The degree of injury was greatest where the ester was applied at ½ pound per acre. No adverse effects were observed as a result of any of the treatments at the remaining growth stages. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Reaction of Barley to 2,4-D when applied at different stages of growth. Olson, P. J. and Friesen, George. A butyl ester of 2,4-D was sprayed on Montcalm barley at 8 ounces acid equivalent per acre, on each of 20 dates starting before emergence and continuing at approximately 3-day intervals until the crop was well past heading. The results supported those of previous years in delineating two widely separated periods during which the crop was particularly susceptible to injury. The first was represented by early seedling stages when the plants were 3 to 6 inches tall and had 2 to 3 leaves. The second occurred in the boot stage 3 to 7 days in advance of heading. The extent of the damage was similar at both stages. Very low yields were also recorded for the 19th treatment date which was 3 days past heading. Very severe lodging was associated with this treatment. (Contribution from the Division of Plant Science, University of Manitoba.)

Oats

Effect of 2,4-D on spring sown Oats when applied at two rates at different growth stages. Davidson, J. G. Ajax, Vanguard, Exeter, Fortune and Clinton Oats were treated at 21 successive stages with water sprays of amine and ester formulations of 2,4-D at the rates of 4 and 8 ounces acid equivalent to the acre. The treatments were made at alternate 3 and 4 day intervals, beginning before the grain had emerged and ended 10 days before the first grain had ripened. Plotted yield curves show practically the same pattern for the five varieties; no reduction for treatments 1, 2 and 3, then yield gradually decreasing to the tenth treatment or early shot blade stage then increasing to normal at the heading stage, about treatment 15. Observed effects on the growing crop were deformed leaves, wilting, deformed panicles, uneven ripening, uneven height, delayed heading, reduced straw strength, leaf browning, blasting and delayed ripening of straw. Deformed leaves were evident on grain sprayed immediately after emergence and the effect ended at the last of the 3 leaf stage. Wilting, deformed panicles and uneven ripening appeared at the 2 to 3 leaf stage and ended at the 3 to 4 leaf. Reduced straw strength first appeared on grain sprayed at the early 3 leaf stage and ended at the early shot blade stage. Leaf browning appeared at the middle 3 leaf stage and ended in

the shot blade. Blasting appeared in the early shot blade stage and ended in the early heading stage. Delayed straw ripening appeared at the 4 leaf stage and ended at the early shot blade stage. The 4 ounce rate of ester appeared to have about the same effect as the 8 ounce rate of amine. (Contributed by the Dominion Experimental Farm, Indian Head, Saskatchewan.)

Differential response of three varieties of oats to treatment with 2,4-D. Friesen, George and Olson P. J. Ajax, Exeter, and Vanguard oats were treated with butyl ester and alkylamine, each at two rates, namely 4 and 8 ounces acid equivalent per acre. The applications were made on two dates, the first on June 6 for all varieties when the plants were 7 to 8 inches tall and had 4 leaves, and the second on July 3 for Ajax, July 4 for Vanguard and July 6 for Exeter. On the second date all varieties were in the flag-leaf or boot stage and approximately a week in advance of heading. On the first date of spraying the 8 ounce rate of ester significantly reduced yields in all 3 varieties the checks averaging 122.02 bus., and the 8 ounce rate of ester 88.34 bus. (N.D. at 5% level 9.29 bus.) No significant reduction in yield took place as a result of the second date of spraying. Disregarding all factors except formulations, the esters reduced yields significantly, while no reduction in yield was recorded for the amines. The results showed no differential variety response, all 3 varieties behaving alike under the treatments applied at the above stages of growth. (Contribution from the Division of Plant Science, University of Manitoba.)

Reaction of oats to 2,4-D when applied at different stages of growth. Friesen, George; Olson, P. J. and Brown, D. A. Butyl ester of 2,4-D was applied as a spray to Ajax oats at 8 ounces pure acid per acre at Winnipeg and at 4, 6 and 8 ounces at Brandon. The applications were made shortly after seeding and before emergence and continued at intervals of approximately 3 days until 20 applications had been made at Winnipeg and 19 at Brandon. Sharp yield reductions were recorded at both places over a period of 15 to 17 days when the plants were advancing from 6 to 7 inches (4 to 5 leaves) to 13 or 14 inches in height (shot blade). At Winnipeg the greatest reduction amounted to 42 bushels per acre (Necessary difference 21.5 bu.) and at Brandon to 29 bushels (necessary difference 8.7 bu.). The drop in yield between the 7th and 8th treatments at both Winnipeg and Brandon was very abrupt, as was the rise between the 12th and 13th treatment at Winnipeg and between the 13th and 14th at Brandon. The yield reduction was most severe for the 8th and 9th treatment at Winnipeg. At Brandon the lowest yields were recorded for the 8th treatment under each of the 4, 6 and 8 oz. rates. At Brandon, smaller the significant yield reduction took place for the 4th, 5th and 6th treatment (plants 2 to 3½ inches tall) in the case of the 8 ounce rate. The 4 and 6 ounce rates caused no significant reductions for these stages. The Winnipeg data showed no significant reductions for these stages. These results agree very well with those for both sites in 1950 and seem to establish that the most vulnerable stages in oats occur from about the 6 or 7 inch stage (4 or 5 leaves) to the very early boot stage. (Contribution from the Division of Plant Science, University of Manitoba and Dominion Experimental Station, Brandon).

Reaction of oats to 2,4-D applied at various growth stages. Friesen, H. A. and Harris, H. D. Plots of Ajax oats were sprayed with the butyl ester at ¼ and ½ pound and a "mixed" amine at ½ pound of 2,4-D acid per acre. The treatments were made at 20 different stages of growth beginning at emergence and continuing at 3 day intervals until the soft dough stage. The 1951 results did not closely follow the observations made in 1949 and 1950. The ester at ½ pound per acre depressed the yield and deformed the plants when applied during the period beginning when the oats were 3 inches tall and continuing until 9 days prior to heading. The critical period appeared to extend from the 7 leaf until just prior to the early boot stage (stages

7, 8 and 9). Head deformities and sterility at these latter stages resulted in yield reductions of almost 50 percent. Furthermore, maturity was delayed by nearly 5 days and plant height was reduced by 3 inches. The results from using the ester at ¼ pound followed a somewhat similar pattern, but notable reductions in yield occurred only at stages 7 and 8. The amine at ¼ pound slightly depressed the yield at stages 7, 8 and 9, thus indicating a much greater crop tolerance to this formulation than to the butyl ester. Onion-like leaves and 2 days delay in maturity resulted at stages 1 2 and 3, and 2 days delay in maturity at stages 14 and 15. None of the remaining treatments had any adverse effect on the crop. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Comparing oil with water as a low volume dilutent for 2,4-D spraying of oats heavily infested with weeds. Wood, H. E., Bourns, J. J., Vodrey, F. C. On June 25, 1951, 15 miles east of Winnipeg, 27 tenth-acre plots of oats some 8" in height, heavily infested with weeds, chiefly wild mustard, wild buckwheat, and perennial sow thistle, were boom-sprayed. Three aromatic oils were used at 1 and 3 imperial gal. per acre, while water was used on the balance at 1, 2, 3, and 4 gal.; except on two plots when amine powder was substituted at 3 oz. per acre, an ester of 2,4-D was added to the dilutent at 2, 3, and 4 oz. per acre. As suitable nozzles for applying 1 and 2 gal. per acre were not to hand these applications were made by increasing the speed of the ground sprayer. Observations made at intervals from a week after treatment to after swathing are summarized as follows: (1) apart from some leaf browning on the oil-treated plots, and this soon disappeared, there was no apparent damage to crop rather the crop was considerably improved through weed competition removal; (2) results from oil at 1 and 3 gal. were comparable, but oil had little advantage over water except on the more resistant weed, wild buckwheat, where better control was obtained than with water; (3) quite comparable weed control was obtained at all dosages, and while 1 and 2 gal. water did not give quite as good control, there was, nevertheless, a large measure of control even at these low rates. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada, co-operating with National Grain Company Ltd., and Imperial Oil Ltd., Winnipeg, Canada.)

Wheat

Effect of 2,4-D on wheat, 1951. Coupland, R. T. 2,4-D amine (a mixture - Naugatuck) and butyl ester were applied at 0, 4, 8, 12, 16 and 32 oz. of acid per acre to quadruplicated plots of Thatcher wheat in three stages of development. Stage 1, June 8, when it was 6 to 7 in. high; stage 2, July 3, when it was in early shot blade at 16 to 20 in. high; stage 3, July 18, after flowering at 31 in. in height. All plots were infested with Salsola pestifer (by seeding). Reduction in stand of weed was 80% or more by ester in the first stage, 8 to 32 oz. of ester in the second stage, and by 8 to 32 oz. of amine in the first and second stages. Vigor of Salsola was also greatly reduced. Effect of herbicide was more important in reducing yield than was reduction of weed competition in increasing yield. Effect of 2,4-D in reducing yield was greatest in stages 1 and 3 and with ester. Reduction in yield was 11 to 20% from 16 oz. of ester and 32 oz. of amine in stage 1 and from 12 and 16 oz. of ester and 16 oz. of amine in stage 3. 20 to 40% reduction was caused by 32 oz. of ester in all stages and by 32 oz. of amine in stage 3. Increase in yield resulted from 4- and 8-oz. rates of both chemicals in the second stage. Height of wheat at harvest was not affected. (Contribution of the Department of Plant Ecology, University of Saskatchewan, Saskatoon, Sask.)

Differential response of three varieties of wheat to treatment with 2,4-D. Friesen, Geo. and Olson, P. J. Redman, Thatcher, and Stewart wheat were treated with a butyl ester and alkylamine in 1951. Each formulation was applied at two

rates, namely 4 and 8 ounces acid equivalent per acre. The applications were made on two dates, the first on June 12 when the plants were 8 to 9 inches tall (seeding date May 9) and the second one on July 3 for Redman and Thatcher and July 6 for Stewart. The results showed no differential variety response under the above treatments. The averages for rates over both dates and all varieties, however, showed highly significant differences between rates. The yield for the check was 53.5 bus., for the 4 oz. rate 51.2 bus., and for the 8 oz. rate 48.0 bus. (Necessary difference at the 5% level 3.5 bushels.) There was no significant difference between the two formulations in this test. (Contribution from the Division of Plant Science, The University of Manitoba.)

Reaction of wheat to 2,4-D applied at different stages of growth. Friesen, George; Olson, P. J.; and Brockey, W. J. Butyl ester of 2,4-D was applied to Redman wheat at the rate of 8 ounces acid equivalent per acre, on each of 20 dates, starting 4 days before emergence and continuing at approximately 3-day intervals until the crop was well past heading. The experiment was conducted at Winnipeg and Morden and was a continuation of one began in 1949 and repeated in 1950. On account of a prolonged drought in spring the germination of the crop at Winnipeg was very ununiform and yield varoation and consequent error large. (Necessary difference 16.48 bu.). At Morden very satisfactory conditions prevailed (necessary difference 3.87 bu.). At Morden sharp and highly significant reductions in yield took place at the 2nd. 3d. and 5th stages, (plants 3 1/2 - 5 1/2 inches tall), and at the 14th stage (boot stage, approximately 8 days before heading) reduction somewhat less in degree, but still significant, occurred. At Winnipeg, although none of the yield reductions were statistically significant, the pattern of results was almost identical with that established at Morden. The results showed good agreement with those obtained in 1949 and 1950. (Contribution from the Division of Plant Science, University of Manitoba, Winnipeg and Dominion Experimental Station, Morden).

Reaction of wheat to 2,4-D applied at various growth stages. Friesen, H. A. and Harris, M. D. Plots of Rescue wheat were sprayed with the butyl ester at $\frac{1}{4}$ and $\frac{1}{2}$ pounds and a "mixed" amine at $\frac{1}{2}$ pound of 2,4-D acid per acre. The treatments were made at 20 different stages of growth beginning at emergence and continuing at 3 day intervals until the early milk stage. The 1951 results supported those of 1949 and 1950 in that there were two widely spaced periods during which the crop was very susceptible to injury. The first was represented by the early seedling stages, i.e. from emergence until the plants were 5 inches tall and had 2 leaves. Each treatment made during this period significantly reduced the yield, the average plant height was reduced by 3 inches and ripening was delayed by 4 days. Almost 100 percent of the treated plants were deformed. The second period occurred in the boot stage 9 to 12 days prior to heading. Each treatment caused a high degree sterility, which consequently resulted in highly significant reductions in the yield of grain. Furthermore, maturity was delayed by 4 days and plant height was reduced by some 2 inches. Severe lodging and the formation of elbow joints resulted from all treatments made during a period of 3 to 12 days after heading, however, the yields were not influenced by these treatments. None of the remaining treatments had any observable effect on the crop. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Effect of systemic herbicides on spring wheat, 1951. Pavlychenko, T. K. Two series of replicated plots on clay loam soil were sown to wheat on May 18th and 25th respectively. One series was treated on the 32nd and the other on the 26th day after emergence with 3, 4 and 5 oz./a of esters of 2,4-D (Weedone Concentrate 48), ACP648 and ACP649; acid (ACP638); low volatile ester (Weedone LV4) and 4,6 and 8oz./a. amine (Weedar 64). Weed infestation was light to moderate and consisted of stinkweed (Thlaspe arvense), Russian Thistle (Salsola kali), wild buckwheat (Polygonum

convolvulus), redroot pigweed (Amaranthus retroflexus) and lamb's quarters (Chenopodium album). RESULTS: None of the treatments caused any significant delay in ripening, but the height occasionally was slightly depressed. M.C.48 caused yield increases on both series with 3 and 4 oz./a., no increase with 5 oz./a. in the first series and slight decrease at 5 oz./a. in the second series. Weedone LV4 gave little or no increase in yield with any of the rates in the first series (more advanced stage) but produced very significant increases (up to 10 bu./a.) in the second series, at 4 oz./a. ACP648 increased yields from 5 to 9 and 5 to 8 bus./a. in the first and second series respectively. ACP649 produced a slight depression of yield in both series. ACP638 increased the yield in the first series, slightly depressed in the second. Weedar 64 gave slight decreases in the first but caused yield increases in the second series. The treatments in this project were well replicated and the results from each replicate consistently followed similar trends in their response to various chemicals. In general they indicate: (1) that 3 to 4 oz./a. of low volatile ester (LV4) are safe and beneficial to wheat; (2) with most chemicals, treatments at the recommended earlier stages are safer. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.,).

Effect of different herbicides on spring wheat, oats and barley. Pre-emergence treatments. 1951. Pavlychenko, T. K. Plots of spring wheat (Triticum vulgare), oats (Avena sativa) and barley (Hordeum vulgare) were treated prior to emergence with TCA and KCN at 5, 10, 15 and 20 lbs./a.; amine of MCP (Weedar MCP) at ½, 3/4, 1, 1½ and 2 lbs./a.; acid of 2,4-D (ACP472) at 1, 2 and 3 lbs./a.; acetanilide of 2,4-D (ACP646A) and mixture of 2,4-D and 2,4,5-T (ACP926) at 1, 1½ and 2 lbs./a. The soil was silty clay loam and growing conditions favorable. RESULTS: TCA appeared to be the most severe on wheat. It virtually prevented emergence at all rates. Oats was unaffected at 5 lbs./a. but reductions in dry weight of 36, 40 and 65 pct. occurred at the 10, 15 and 20 lbs/a. rates. Barley was unaffected at 5 lbs./a., reduced 64 pct. in dry weight by 10 lbs./a. and was totally prevented from emerging by the 15 and 20 lbs./a. rates. Weedar MCP had little or no effect on the emergence, stand and vigor of wheat, oats and barley, only in a few plots a slight reduction in dry weight occurred. The same was true of ACP472 and ACP646A, although barley was perhaps a little more susceptible to damage than oats and wheat. ACP926 and KCN had no measurable effect on the three grain crops. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon Sask.).

Rye

Effect of systemic herbicides on spring rye. 1951. Pavlychenko, T. K. Two series of replicated plots on clay loam soil were sown to rye on May 18th and 25th respectively. The first series was treated on the 37th and the second on the 28th day after emergence with 3, 4 and 5 oz./a. of esters of 2,4-D (Weedone Concentrate 48, ACP648 and ACP649); acid (ACP638); low volatile ester (Weedone LV4), and 4, 6 and 8 oz./a. amine (Weedar 64). Weed infestation was medium to heavy, consisting of stinkweed (Thlaspe arvense), Russian thistle (Salsola kali), wild buckwheat (Polygonum convolvulus), redroot pigweed (Amaranthus retroflexus) and lamb's quarters (Chenopodium album). RESULTS: No significant delay in maturity, vigor or height was caused by any chemical at the rates used. There was a slight depression in height and yield in the early series due to incomplete weed control in 3 oz./a rates (Weedone Concentrate 48 reduction 3.7 bus./a.; ACP648, 3.3 bus./a; Weedone LV4, 2.9 bus./a.) and some injury to crops at 5 oz./a. (ACP648, 2.5 bus./a.). Most of the common weeds were fully controlled by 4 and 5 oz./a. but some survived in the 3 oz./a. rates. Wild buckwheat was only stunted, even in 5 oz./a. plots. In the second (late) series, all chemicals except ACP648 gave very significant increases in yield, even at 5 oz./a rates. Weedone LV4, 3 oz./a., gave the highest increase of 12.6 bus./a.; ACP648 reduced the yield at 3 and 4 oz./a. rates but gave increase of

4.5 bus./a. at 5 oz./a. In general, treatments at the recommended earlier stages were more beneficial to crops and more harmful to the weeds. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.).

All cereals and flax (other chemicals)

Response of cereals and flax to TCA, IPC and MH. Coupland, R. T. TCA, IPC and MH were applied to cereals (oats, wheat, barley) and flax at Saskatoon at the following rates: 0, 2.5, 5, 10, 20, 40 and 80 lb. of acid per acre in 75 gallons of water. Treatment was made on June 29 to crops in two stages. Stage 1 (sown June 4), wheat - 5 to 6 in., barley - 9 to 10 in., oats - 7 to 8 in. and flax - 4 to 5 leaves; stage 2 (sown June 26), pre-emergence. In the pre-emergence treatment 80 lb. of TCA and 40 and 80 lb. of IPC caused slight damage to cereals, while flax suffered slightly from 80 lb. of TCA and severely from 40 and 80 lb. of IPC and MH. Post-emergence treatments causing severe damage to cereals and flax were 20, 40 and 80 lb. of MH, 80 lb. of TCA, and 40 and 80 lb. of IPC. Considerable damage resulted from 20 lb. of IPC and 40 lb. of TCA. All other treatments resulted in no observable damage. (Contribution from the Department of Plant Ecology, University of Saskatchewan, Saskatoon.)

Effect of MCP on weeds and crops. Foster J. Roe and Holberg, E. S. Butyl ester, sodium salt, and amine formulations of MCP (2-methyl-4-chlorophenoxyacetic acid) were applied to Thatcher wheat, Exeter oats and Montcalm barley in 1951. An ethyl ester of 2,4-D was included for comparison. Rates of 2, 4, 8 and 16 ounces of acid equivalent per acre were applied to quadruplicated plots 1/2 square rod in size. The applications were made 3 weeks after emergence of the crops. At this time the weeds, principally wild mustard (Sinapis arvensis) were in the rosette stage. All MCP treatments controlled the weeds as well as the 2,4-D at comparable rates, except the 2 ounce rate of the amine MCP which gave 86.2% weed kill compared with 91.7% for the 2,4-D. The MCP caused less delay in maturity in the barley and less lodging in the oats, particularly with the 8 and 16 ounce applications. Yield data are not yet available. (Contribution of the Dominion Experimental Sub-Station, Regina, Saskatchewan Canada.)

Disodium 3,6-endoxyhexahydrophthalate as an herbicide for wheat in the boot stage of development. Le Tourneau, Duane and H. G. Heggeness. Plots of Rival wheat were sprayed with HE-3001 (disodium 3,6-E plus ammonium sulfate) at rates of 1/4 1/2 1, 2, and 3 lbs. per acre and HE-3003 (aqueous solution of disodium 3,6-E) at rates of 1/2, 1, 2, 3, and 6 lbs. per acre. All treatments were as aqueous sprays, 75 gallons per acre. Applications were made in quadruplicate when the wheat was in the boot stage of development. The lowest rates caused a 20-25% reduction in stand and a 10% reduction in the height of the wheat while the highest rates caused a 50% reduction in stand and a 25% reduction in height of the wheat. Intermediate rates gave intermediate responses. Polygonum species were controlled partially or completely by all rates of both formulations. Setaria species, Brassica arvensis, and B. alba were usually mature at the time of spraying and there was little effect on these species. Chenopodium album was resistant to all rates of both formulations. Cirsium arvense plants were beginning to flower at the time of spraying. Heavy rates (2 and 3 lbs. of HE-3001 and 3 and 6 lbs. of HE-3003) either killed C. arvense or prevented flowering because of burning of the unopened flower, while lower rates caused a foliar burning but did not kill the plants. (Contribution from the Division of Plant Pathology and Agricultural Botany, Minnesota Agricultural Experiment Station. Paper No. 2744, Scientific Journal Series Article, Minnesota Agricultural Experiment Station.)

Application of Isopropyl-N-phenylcarbamate at 6 locations in Minnesota to control wild oats in 1951. MacDonald, J. P.; Zinter, C. C.; Slough, A. T. 50% IPC was applied at 2, 4, and 8 lbs. acid equiv. per acre at 3 locations as a pre-emergence spray for wild oats before flax was seeded. At 3 other locations it was applied on land seeded to barley but before emergence with wild oats just emerging. IPC applied with water at rate of 320 gals. per acre. All plots dragged and/or otherwise tilled immediately after spraying. In no case was there discernable control of wild oats or injury to crop. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis, Minn.)

The relative tolerance of field crops to residues of TCA in the soil. Robinson, R. G. and R. S. Dunham. Applications of TCA at various rates were made to an old quackgrass sod in September 1948, 1949, and 1950. Continued cropping has followed the fall applications and yields have been taken to determine injury from the residues of TCA.

Soybeans planted in 1949 following applications of 0, 11, 22, 44, 66, 88, and 176 lbs. acid equivalent per acre in September 1948 showed such severe injury from all rates that no yields were taken. In 1950, yields were materially reduced by the 1948 applications of 44, 88 and 176 lbs. per acre. In 1951 no injury was apparent so no yields were taken. Applications made in September, 1949 and 1950 also severely injured soybeans planted the following spring.

Corn planted in 1949 following similar applications made in September, 1948 was slightly injured by 11 lbs. and severely damaged by all higher rates, but no yields were obtained. Corn planted in 1950 following September treatments in 1949 was again severely injured at rates of 31, 44, 66, and 88 lbs. per acre. Corn planted in 1951 following September treatments in 1950 of 22 lbs. per acre showed no injury or reduction in yield. Corn planted in May, 1951, on land that had received 22 lbs. of TCA in April, 1951 was killed.

Flax sown in 1949 following applications of 0, 11, 22, 44, 66, 88, and 176 lbs. per acre in September 1948 showed leaf firing from the 88 and 176 lb. rates. Yields were not taken but there was no apparent injury from the other rates. The yield of flax sown in 1950 following applications of 31, 44, 66, and 88 lbs. per acre in September 1949 was reduced only by the 88 lb. rate. Yields of flax sown in 1951 following both September, 1950 and April, 1951 applications of 22 lbs. per acre were not reduced.

Mindo oats sown in 1949 following applications of 11 to 176 lbs. per acre in September 1948, matured without any apparent injury. Symptoms of injury on soybeans, corn, and flax appeared in June and July after the oats were fully headed. The yields of Mindo sown in 1950 following applications of 31 - 88 lbs. per acre in September, 1949 were not reduced.

Wheat, barley, oats, and flax were sown in 1951 following applications of 0, 22, 31 and 44 lbs. in September, 1950. Wheat was practically eliminated. Barley yields were severely reduced by 44 lbs. and injury was apparent at 31 lbs. Oats showed no injury at any rate but yields were slightly lower on treated plots. Flax showed no injury or yield reduction from any rate. Red clover was sown with flax. Stands were reduced 30% by the 22 lb. application, and about 65% by 31 and 44 lbs.

Tolerance of the crops used was in the following descending order: flax, oats, corn barley, wheat, and soybeans. Red clover appeared less tolerant than alfalfa. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No.2752, Sci. Jour. Series, Minn. Agr. Exp. Station).

Project III. Control of Weeds in Field Crops.

Fall-planted Wheat, Oats, and Barley — J. W. Zahnley

Summary

Three stations located in Indiana, Oklahoma, and Kansas reported on the effect of chemicals on winter wheat. In addition to 2,4-D work was reported with 2,4,5-T, maleic hydrazide, IPC, and TCA.

The effect of maleic hydrazide was most severe. An application as low as 6 pounds per acre practically destroyed all wheat treated in both fall and spring.

IPC and TCA at rates above 6 pounds per acre destroyed the wheat and reduced yields resulted from the 6 pound rate.

2,4-D and 2,4,5-T at rates of 2, 4, and 8 pounds reduced yields severely when applied in the fall. Spring treatments in the higher rates reduced yields, but the damage was less than from those made in the fall.

Applications of 1 pound 2,4-D acid per acre caused no damage from any of the eight dates of application in the spring. Three of the seven fall applications caused significant reductions in yield.

Six varieties of wheat responded alike to treatments of 1/2 and 3/4 pound of ester and 3/4 pound of amine. A slight decrease in yield from the boot stage treatment was the only adverse effect in the Oklahoma tests.

Appreciable damage resulted from pre-harvest application of 2,4-D to wheat in the milk to stiff dough stage. Pre-harvest treatment should be looked upon as an emergency measure to be used only where weeds are likely to interfere seriously with harvesting. Earlier spraying when wheat is in the early jointing stage is safer and more effective.

Abstracts of Results of Cooperators

Effect of 2,4-D on Winter Wheat Varieties at Different Stages of Growth. Elder, W. C. and Gassaway, J. E. Clarkan, Comanche, Pawnee, Triumph, Westar and Wichita varieties of winter wheat were planted September 7, 1950. The wheat made very good growth for three weeks, dry weather thereafter in the fall months produced little growth. The fall tiller treatment was made October 26, 1950. The wheat had stooled at this time, however weather conditions were unfavorable for good growth at the time of treatment. Spring tiller treatments were made April 2, 1951 on small poorly developed plants. The boot and dough treatments were made according to the maturity of the individual varieties. 2,4-D was applied in 40 gallons of water per acre at rates of 1/2 and 3/4 lb. of ester and 3/4 lb. amine per acre. Contrary to former tests the fall tiller treatment did not affect the wheat. No apparent injury to the leaf, as in former years, occured and the yields were no different from the check plots. Apparently the non-injury was due to dry conditions at the time of treatment; also the wheat was well stooled at time of treatment. As in former years there were no significant differences in yields from the spring application of 2,4-D, however there was a slight decrease in yields for the boot stage treatment. All wheat varieties in this study for the last four years have responded alike to the 2,4-D treatments. (Contribution of the Agronomy Department, Oklahoma Experiment Station, Stillwater, Oklahoma.)

Effect of Pre-harvest Application of 2,4-D on Winter Wheat. Zahnley, J. W. and McCall, G. L. A survey study of the effect of pre-harvest treatment of hard red winter wheat with 2,4-D in the wheat belt of Kansas was made in 1951. Thousands of acres are treated in Kansas each year to reduce weed growth which threatens to interfere with combining. The treatments this year consisted of an application of 1/2 to 2/3 pound of 2,4-D acid in the ester form at stages ranging from milk to stiff dough. Damage resulted in approximately 70 percent of the fields treated. The effect of the chemical was manifest in elongation and weakening of the top nodes which became brittle and broke over within 3 to 5 days after treatment. The brittleness was a temporary condition and breaking over stopped within about a week after it started. Determinations of the extent of damage in 15 representative fields showed an average of 6 percent broken stems, with limited areas ranging up to 50 percent broken. Damage this season has been more severe than in previous years. Water soaked soil, high humidity, poor root development of much of the wheat and early dying of the leaves are conditions which may have contributed to the greater susceptibility of wheat to the chemical. The loss was greater in fields of thin stands and weak growth of the plants. (Contribution of Department of Agronomy, Kansas State College.)

Effect of 2,4-D, 2,4,5-T, Maleic Hydrazide, IPC and TCA on the Yield of Vigo Wheat. Zalik, Saul, Gries, G. A., and Lee, C. C. Two, 4, and 8 pounds acid per acre of the isopropyl ester of 2,4-D and of 2,4,5-T (each applied in water and in kerosene), 6, 12, and 24 pounds acid per acre of maleic hydrazide and of IPC, and 6, 12, and 36 pounds of TCA were applied to Vigo winter wheat on October 19, 1950 (4 inches to tip of leaf), April 17, 1951 (5 inches to tip of leaf), and May 1, 1951 (8 inches to tip of leaf). The applications of 2,4-D and 2,4,5-T in the fall reduced the yield of Vigo wheat severely. This was more marked when applied in kerosene. While there were statistically significant reductions in yield from the higher rates applied in the spring the reductions were not so marked. Maleic hydrazide practically destroyed the wheat at all rates and dates of application. IPC and TCA practically destroyed the wheat in all the applications except the 6, and 12 pound rates applied in April and May. Even these resulted in statistically significant reductions in yield. In a separate experiment 2,4-D at the rate of 1 pound acid per acre was applied to Vigo wheat at 15 dates. Seven applications were made in the fall of 1950, and eight in the spring of 1951. Significant reductions in yield resulted from the applications made on October 19 (4 inches), October 24 (5 inches) and October 27 (5.5 inches). There was no significant effect upon yield from any of the other dates of application. (Contribution of the Department of Botany and Plant Pathology Agricultural Experiment Station, Purdue University, Lafayette, Indiana.)

Project III. Control of Weeds in Field Crops.

Corn C. J. Willard

Summary

Corn. Ten abstracts were received from six Stations - a sharp reduction from earlier years. 2,4-D was still the most widely used material, but data on 2,4,5-T, CMU, TCA, and several other herbicides were included.

Both pre-emergence and post-emergence 2,4-D were reported as damaging corn. An application of 2 lb./A. of an ester at or from 2 to 3 days before emergence cut the yield significantly at 3 locations. On the other hand, 3 locations reported satisfactory use of 1 to 2 lb./A. of several formulations of 2,4-D pre-emergence. At 2 locations, 2,4-D applications 3 to 6 days after emergence all but destroyed the corn. It would seem desirable to change last year's recommendations on using pre-emergence rates post-emergence before the 4-leaf stage. Combinations of 2,4-D and TCA and 2,4-D with CMU were satisfactory in one test of each.

CMU gave promise, but since corn injury almost paralleled weed control, further tests are necessary. 2,4,5-T caused no more injury to corn than 2,4-D at the same stages, possibly less. 2,4,5-T will control some weeds on which 2,4-D is ineffective. Tests with several other herbicides were briefly reported.

The need for cultivation in addition to herbicide treatments, and for applying 2,4-D low in tall corn, was again demonstrated.

Abstracts of Results of Cooperators.

Control of annual weeds in corn with herbicides and tillage. Dunham, R. S. and Robinson, R. G. In 1950, pre-emergence treatments were: 2,4-D amine at 2 lb./A. plus (1) 2 cultivations, (2) 1 lb. 2,4-D post-emergence, and (3) 1 cult. + 2 lb. 2,4-D at last cult The normal cultivation treatments included 4 cult. with a corn cultivator plus the following chemicals applied to the soil at the last cult. (4) no treatment, (5) 500 lb. calcium cyanamid per acre, (6) 1½ lb. 2,4-D, amine, (7) 3 lb. 2,4-D, amine, (8) 13.2 lb. TCA, and (9) 13.2 lb. TCA + 3 lb. 2,4-D, amine. Rates of TCA and 2,4-D are of acid equivalents. Foxtail millet was sown across all plots at the last cultivation to provide a uniform stand of grass weeds. No significant differences in yields resulted from any treatment. The pre-emergence treatment (2) was completely ineffective in weed control. Treatments 1 and 3 were no more effective than cultivation alone. All normal cultivation treatments plus chemicals resulted in better weed control than cultivation alone. Best control resulted from treatments with TCA.
In 1951, the following pre-emergence treatments were applied: (1) 2 lb. 2,4-D ester, (2) 2 lb. 2,4-D ester plus 2 cult., (3) 1 lb. 2,4-D ester at first leaf stage of the corn, (4) 1 lb. 2,4-D ester when corn had 3 leaves and Setaria spp. had emerged. Normal cultivation trials included 4 cult. + these treatments to the soil at last cult.; (5) no treatment, (6) 4.4 lb. TCA + 2 lb. 2,4-D amine, (7) 8.8 lb. TCA + 2,4-D amine, (8) 13.2 lb. TCA + 2 lb. 2,4-D amine. Rape and foxtail millet were sown across all plots at the last cultivation to provide a uniform stand of weeds. Yield data are not available now but treatments 3 and 4 ruined the crop. No pre-emergence treatment without cultivation controlled weeds. All TCA plus 2,4-D treatments gave excellent weed control. (Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2756 Sci. Jour. Series, Minn. Agr. Exp. Station.)

Effect of herbicides and cultivations in various combinations for control of weeds upon yield of corn on upland and overflow bottom land soils. Freeman, J. F., Josephson, L. M., and Hansen, J. R. On upland soils late cultivation to control annual grass weeds was required in addition to earlier effective weed control practices for normal yields of grain. On overflow river bottoms where control of broadleaved weeds is of chief concern, substitution of 2,4-D post-emergence sprays for one or two of either of the three cultivations, or pre-emergence treatment for the first two cultivations gave satisfactory weed control and normal yields of corn. On upland soils during 1949, 1950, and 1951 the following combination treatments replicated in random complete block design were compared: (1) no control, (2) early and late cultivations, (3) early post-emergence 2 4-D sprays (0.4 lb. amine) and late cultivation, (4) early cultivation and late 2,4-D spray, (5) pre-emergence 2,4-D amine - 2 lb. rate and no cultivation, (6) pre-emergence 2,4-D spray and late cultivation. Principal weeds were redroot pigweed, ragweed, and crabgrass. The average annual yield of corn for the several combination treatments stated as the percent yield of the twice-cultivated treatment were: (1) 42, (2) 100, (3) 94, (4) 88, (5) 82, and (6) 101. On overflow bottom soils of the Ohio river in Daviess County during 1950 and 1951 the following combination treatments replicated in random complete block design were compared: (1) no control, (2) cultivated 3 times, (3) post-emergence 2,4-D ester (0.4-pound rate) substituted for (a) first cultivation, (b) second cultivation, (c) third cultivation, (4) post-emergence 2,4-D ester treatments substituted for (a) first and third cultivations, (b) first and second cultivations, (c) second and third cultivations, (5) pre-emergence 2,4-D ester, 1.5-pound rate plus late post-emergence 2,4-D treatment. The average annual yields for the several combination treatments stated as the percent of the thrice-cultivated treatment were: (1) 42, (2) 100, (3) 99 (av. a, b, and c), (4) 99 (av. a, b, and c), (5) 100. (Kentucky Agr. Exp. Station.)

Pre-emergence treatment with 2,4-D for the control of annual weeds in corn. Friesen, George and Olson, P. J. 2,4-D was applied as a pre-emergence spray to two varieties of corn at Winnipeg in 1951. The rates used were 1 and 2 lb., acid equiv. per acre of alkyl amine and butyl ester. Treatments were applied 2 days before the corn emerged. Argentine rape was broadcast at the time of planting to simulate common mustard. The experiment was so designed that one part of the series was given one cultivation 3 weeks after emergence, while the other received the chemical treatment only. Very good weed control was obtained on the cultivated plots, only the unsprayed check showing some weeds during late summer. The yield differences in this part of the experiment were not statistically significant, although the data for the unsprayed plots and the 2 lb. ester rate suggest slightly lower yields, due, no doubt, to the presence of weeds, and possible 2,4-D damage, respectively. In the uncultivated part of the experiment essentially the same pattern of results prevailed. However, the weed population was much higher and lower yields were recorded throughout. Here highly significant yield reductions were recorded for the unsprayed plots and the 2 lb. ester plots. The untreated check was so heavily polluted with weeds that the corn was all but smothered out. The plot which received the 2 lb rate of ester was practically free from weeds throughout the summer. Its reduced yields must therefore be attributed to damage by the chemical. The plot at 1 lb. of amine contained considerably more weeds than the other treated plots. (Division of Plant Science, University of Manitoba.)

Responses of corn and weeds to pre-emergence treatments. Hamilton, K. C., Fuchholtz, K. P. Six herbicides were applied to dent corn planted on May 25. The area was also sown with mustard and millet to provide abundant weedy growth. On May 28 the plots were treated at these acre rates: 3-p-chlorophenyl-1,1-dimethylurea (CMU) and an ester of 2,4-D, 1, 2 and 4 lb., endothal 2, 4 and 8 lb., TCA 4, 8, and 12 lb., DN and chloro-IPC 8, 12 and 16 lb. The Miami silt loam soil was damp when the materials were applied in water equivalent to 40 gals. per acre. Single rows of corn 6 feet long containing 10 plants were used with 4 replications. No cultivations were made except on the cult. checks. TCA reduced the corn stand significantly below the other materials and check. Endothal was the only material not sig. reducing the grassy weed stand. Highly sig. control of broadleaf weeds was obtained with all materials except TCA, which had more than the uncultivated check. The mustard growth on the uncultivated check and the plots treated with endothal and TCA became so dominant by July that the plots were mowed. By late fall the plots treated with 2 and 4 lb. of CMU were still free of weeds except quackgrass. The average yields of plots treated with chloro-IPC, 2,4-D, DN, and CMU were 57, 51, 103, and 92 bu. per acre resp., while the check plots yielded 94 bu. The first two yields were significantly less than the others. (Dept. of Agronomy, Univ. of Wisconsin, Madison, Wisconsin.)

Pre-emergence treatment of corn with several herbicides. Hansen, J. R. and Freeman, J. F. Kentucky 102 hybrid corn was planted in silty clay loam soil May 18, 1951. Occasional shoots were emerging when plots were treated on May 23 and 24. Herbicides and lb./A. rates were ester of 2,4-D, 1.5; low volatile ester of 2,4-D, 1.5; alkanol-amine salt of 2,4-D, 1.5; CMU, 1, 2, and 4; N-1-napthyl phthalamic acid, 3 and 6; alkanolamine salt of DNOSBP, 4 and 8; and Endothal, disodium salt, 2 and 4. Endothal at 2 pounds and CMU at 1 pound were also each applied with 1 pound 2,4-D amine. A cultivated and an uncultivated check were included. 1/100 acre plots, replicated four times, in a randomized complete block arrangement. A total of 0.4 inches of rain fell on two days following the treatments. Principal weeds were crabgrass and redroot pigweed. Plots were not cultivated at all, except for one check. Complete weed control for the season was had with CMU at 2 and 4 pounds, but stands were reduced by these rates. Yields ranged from 4 bu. per acre in the uncultivated check to 68 in the cultivated check. Of the chemical treatments, highest yields were obtained with 2 pounds CMU or 1 pound each of CMU and 2,4-D, which were 46 and 47 bu. respectively. The 2,4-D materials averaged 35 bu. DNOSBP and phthalamic acid were less effective in weed control at all rates than 2,4-D at 1.5. These gave similar results with yields of 20 to 30 bu. Treatments with endothal alone were similar to the uncultivated check. In an adjacent experiment 400 pounds of calcium cyanamide applied after planting and one late cultivation gave yields equal the clean cultivated check, while yields were significantly lower with an equal amount of nitrate nitrogen and one cultivation. However, weed control was not satisfactory with cyanamide. (Kentucky Agricultural Experiment Station.)

Pre-emergence and early post-emergence 2,4-D on corn. Hill, G. D. and Willard, C. J. Ohio C38 corn was drilled May 15 in 38 inch rows on Miami-Brockston soil, 4-row plots. Herbicides were applied in 10 gallons solution as follows (rates in lb. acid equiv./acre): Polypropylene ester, 1/2, 1, 2 and 4; isopropyl ester, 1 and 2; and amine salt, 1 and 2. Checks with and without cutlivation. Triplicate plots were treated on six dates: May 17, May 20 (coleoptile visible), May 23 (2 leaves), May 29 (3 to 4 leaves), June 1 (5 to 6 leaves), and June 5 (8 leaves). No damage to corn at the first two stages. Plants treated May 23 appeared nearly normal for 3 weeks, then developed severe spiking and stunting. Fifty percent of the main stalks did not recover but produced only suckers. When compared to check

with cultivation, yields were reduced 40 bu./acre by 2 and 4-pound rates of poly ester and 30 bu. by ½ and 1-pound rates of poly ester. One pound amine caused only slight reduction in yield. On May 29 all rates and formulations reduced yield 20 bu., but less damage to corn than in 2 leaf stage. In 5-6 leaf stage, no twisting or spiking, but inhibited growth and decreased yields with 2 and 4 pound rates of esters. In 7-8 leaf stage plants treated with 2 and 4 pound rates showed severe leaf roll but recovered with slightly decreased yield. Excellent weed control was obtained through 2-leaf stage with 2 and 4 pounds, 1 pound not enough on Brookston (high organic matter) soil. Although treatment at later stages gave good control on broadleaf weeds, grasses had emerged before treatment and were not killed. (Ohio Agricultural Experiment Station.)

Early post-emergence 2,4,5-T on corn. Hill, G. D. and Willard, C. J. Replicated 4-row plots on non-uniform Miami-Brookston soil. Ohio C38 corn drilled on June 6. Corn treated 6 days after planting, coleoptile visible. Polypropylene ester of 2,4,5-T (Esteron 245) was applied at ½, 1, 2 and 4 lb., acid equivalent, per acre in 10 gallons of solution. The ½ pound rate controlled 50 percent of annual grasses and broadleaf weeds; 1 lb. gave adequate control of all annuals on Miami soil but was not enough on the Brookston soil; 2 and 4 lb. rates resulted in excellent control of annual weeds on both soil types. Canada thistle (Cirsium arvense) was controlled by the 4 lb. rate, which was applied before the emergence of thistle. No regrowth of thistle noted. The 2 lb. rate reduced the growth of corn on the Miami soil but not the Brookston, while the 4 lb. rate caused definite injury to corn on both soils, especially manifested by shorter corn at harvest. From appearances, yield will be reduced somewhat 4 lb. rate. (Ohio Agricultural Experiment Station.)

Effect of 3-(p-chlorophenyl)-1,1-dimethyl urea (CMU) as an early post-emergence spray on corn. Hill, G. D. and Willard, C. J. Replicated 4-row plots on non-uniform Miami-Brookston soils, Ohio C38 corn drilled on June 6. Corn treated 6 days after planting, coleoptile visible. CMU was applied at ½, 1, 2, and 4 lb. active ingredient per acre in 40 gallons solution. No heavy rains fell for one week after application. One-half pound rate gave poor weed control. Treatments of 1 lb. resulted in 90 percent control of annual grasses and broadleaf weeds, while 2 and 4 lb. gave excellent control of annual grasses and broadleaf weeds, partial control of Canada thistle (Cirsium arvense), but no visible effect on horsenettle (Solanum carolinense) and climbing milkweed (Gonolobus laevis). None of the rates were toxic to corn on Brookston soil. The 4-lb rate caused severe damage to corn on the Miami soil. At least 25% of the plants died and the remainder turned yellow and grew slowly throughout the season. (Ohio Agricultural Experiment Station.)

Tolerance of corn to 2,4,5-T. Lee, Oliver C. and Zalik, Saul. Replicated plots of corn were sprayed at two stages of growth with 2,4,5-T at rates of 0.25, 0.5 and 1.0 pound of acid per acre. Sprays were applied when corn was 12 inches in height and just before tasseling or at a height of approximately 6 feet. The latter application was applied as a basal spray. All rates made during the early stage of growth caused some lodging and malformation of brace roots. No visible effect was noted from spraying made just prior to tasseling. No significant reductions of yields were found. The average yield of check plots was 101.9 bu. 0.25 lb. applied at 12 inch height produced 102.9, 0.5 lb. 95.1 and 1.0 lb. 100.0. When sprayed just prior to tasseling the yields were 108.7, 111.1 and 102.7 bu. per acre at rates of 0.25, 0.5 and 1.0 of acid per acre respectively. Plots sprayed with 2,4-D when corn was 12 inches in height produced 104.7 bushels. The tolerance

of corn to 2,4,5-T is of interest as this material has proved to be effective in the control of wild cucumber, a common weed of corn fields in the southern part of Indiana. (Department of Botany and Plant Pathology, Purdue University, Lafayette, Indiana.)

Effect of partial vs. total coverage of corn with 2,4-D and TCA. Robinson, R. G. and Dunham, R. S. In 1950, corn was sprayed with 2,4-D,amine at 3 lb. acid equivalent, per acre covering (1) the entire plant, (2) the lower 12 inches and (3) the lower 6 inches. Spraying at the last cultivation was compared with spraying after silking was complete. Sixteen gallons of spray were used per acre. A few days after the last cultivation a severe windstorm broke brittle stalks. At harvest, there was only a trace of broken stalks in unsprayed corn and in that sprayed after silking. In that sprayed at the last cultivation, there were 39% broken stalks where the entire plant had been covered, 32% where the lower 12 inches had been covered, and 14% where the lower 6 inches had been covered. Yields were not reduced significantly when the corn was sprayed after silking but covering the entire plant resulted in a 6.5 bu. decrease. Spraying at the last cultivation reduced all yields, although when only the lower 6 inches were covered the reduction was not significant at the 5% level.
In 1951, TCA at 8.8 lb. acid equivalent, per acre was used at the same stages and for the same coverage as 2,4-D in 1950. The 2,4-D trial was continued for the after-silking stage only. Twelve gallons of spray were used per acre. Severe leaf burning followed spraying the entire plant with TCA. Lower leaves were burned with the other applications. The damage from spraying after silking was less severe than at the last cultivation. No damage was observed from any applications of 2,4-D. Yield data are not available at this writing.
(Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2751, Sci. Jour. Series, Minn. Agr. Exp. Station.)

Evaluation of chemicals for pre-emergence weed control in corn. Slife, F. W. The following chemicals have been used as a pre-emergence spray on corn 4 days after planting: 2,4-D dimethyl amine - 1 and 1½ lb. acid per acre; 2,4-D isopropyl ester - 1 and 1½ lb. acid per acre; polyethylene glycol butyl ether ester of 2,4-D - 1 and 1½ lb. acid per acre; MCP - 1 and 1½ lb. of acid per acre; CMU - 1/4, 1/2, 1, and 2 lb. per acre; and E.H. 1 - 4 and 8 lb. per acre. The soil, a heavy black silt loam, was high in organic matter. Rainfall and temperature records were normal for the season with .7 of one inch of rain falling 2 days after the application of the chemicals. Excellent weed control resulted from all these chemicals on all plots, except CMU at 1/4, 1/2 and 1 lb. per acre. These three rates did not control the weeds, but 2 lb. of CMU per acre gave excellent control. Four pounds of E.H. 1 gave excellent weed control, but 8 lb. caused some stand reduction. Weed counts taken at three times during the season do not show any significant difference between MCP, the various 2,4-D formulations, CMU at 2 lb. per acre, or E.H. 1 at 4 lb. per acre. Yields are being tabulated.
(Illinois Agricultural Experiment Station.)

Project III. Control of Weeds in Field Crops.

Sorghums

W. C. Elder

Summary

Only two abstracts from one state were submitted on sorghums. One abstract reports response of sorghum varieties to different herbicides and the other gives results from using herbicides at different growth stages of the sorghum.

The most noticeable injury to sorghums treated with 2,4-D, 2,4,5-T and MCP is brace root deformation. This characteristic growth can be observed where very light applications are used that do not affect grain yields. Severe root injury confines the roots to a small area, causing dwarfing of the plant, possible delay of maturity, and small heads that do not emerge from the boot.

In the past years, ester formulations were reported more injurious to sorghums than amine salts of 2,4-D, however, one abstract this year reported no difference between the two. One year's results with MCP indicate this material is much more injurious to sorghums than 2,4-D. One report last year, and confirmed by tests this year, shows 2,4,5-T to damage sorghums less than 2,4-D.

Sorghum varieties differed in their response to the treatments as in past years, making it possible to list some varieties as susceptible or resistant to 2,4-D. As a general rule, forage types are more resistant, milo groups more susceptible, and the intermediate group, composed of kafirs and miscellaneous (darso, hegari).

1 1/2 lbs. of 2,4-D as a pre-emergence treatment did not damage young sorghums, however, injury to young plants from pre-emergence has been reported in past years. Results this year and in former years indicate that young sorghum plants (3" high) are more susceptible to 2,4-D than older plants. Also, there is danger from treatments in the blooming stage.

Project III. Control of Weeds in Field Crops.

Sorghums

Abstracts

Response of 6 combine sorghum varieties to 2,4-D, 2,4,5-T and MCP treatments. Elder, W. C., Davies, Frank F., and Gassaway, J. E. Varieties used in test: Martin, Midland, Redlan, Westland, Wheatland and Dwarf Kafir 44-14. Rates and chemicals used: 1/4, 1/2 and 1 lb. 2,4-D ester per acre and 1 lb. per acre each of 2,4-D amine, 2,4,5-T amine and MCP. The sorghums were planted in 3 1/2 ft. rows and hand thinned to 3 plants per hill, spaced 30 inches apart. The chemicals were applied when the sorghums were 12 to 15 inches tall, using 40 gal. of water per acre. It was evident a few days after application that some of the treatments were causing considerable injury, especially to certain varieties. A wind and rainstorm caused breakage in the 1 lb. treatments on Wheatland, Westland, and Midland varieties. In some MCP plots this breakage was 3%. All treatments exhibited brace root deformation, but it was very plain that MCP was causing severe injury. Wheatland, considered susceptible to 2,4-D treatments, was dwarfed by 1 lb. MCP and the small heads emerged only half-way out of the boot. However, this severe injury caused suckering and with the favorable season produced many small heads making the grain yield just under the check plots. 1 lb. MCP lowered grain yields in Westland 40% and Midland 30%. It reduced production slightly in Martin and Redlan, but did not affect Dwarf Kafir 44-14. In this test 1 lb. amine of 2,4-D was just as injurious as 1 lb. ester of 2,4-D. Both lowered grain yields in the susceptible varieties but had no effect on grain yields of resistant varieties. 2,4,5-T (amine) was less injurious to sorghums than the 2,4-D formulations. 1 lb. per acre of 2,4,5-T (amine) had little effect on grain yields. 1/4 and 1/2 lb. rates of 2,4-D ester caused brace root deformation, but did not affect the yields in any of the sorghum varieties. (Contribution of Agronomy Dept., Okla. Experiment Station, Stillwater, Okla.).

The effect of herbicides on sorghums applied at different stages of growth. Elder, W. C., and Gassaway, J. E. Treatments were made on Wheatland grain sorghum drilled in 21 inch rows. The crop was not cultivated and a heavy growth of crabgrass effected crop yields. Immediately after planting 4 and 8 lbs. Dows Pre-emerge, 1 1/2 lb. 2,4-D (ester) and 1 lb. CMU per acre were applied as a pre-emergence spray. 2,4-D and CMU controlled crabgrass, however, some injury was noticeable on the CMU treatments. 8 lbs. of Dows Pre-emerge did not control the grass as well as CMU, but made the same grain yield. 2,4-D plots produced the greatest yield, while 4 lb. Dows Pre-emergence increased the yield over check plots, but the control of crabgrass was unsatisfactory. 1 lb. per acre each of 2,4-D (amine), 2,4,5-T (amine) and MCP was applied on the growing sorghum at 3, 6 and 12 inch, boot and bloom stages of growth. Although the first treatment controlled much of the crabgrass, all three chemicals caused severe injury to the young plants. In this test, the last four treatments did not affect the sorghum materially. In the first treatment, MCP was more injurious to the plants than 2,4-D and the 2,4,5-T caused less injury than 2,4-D. It appears that drilled sorghum is injured less by the above treatments than sorghums planted in rows and cultivated. At least deformation of the roots on the small stalks is not as noticeable. (Contribution of Agronomy Dept., Okla. Experiment Station, Stillwater, Okla.).

Project III. Control of Weeds in Field Crops.

Soybeans, peas, and leguminous forage. John H. Miller

Summary

Thirty-five abstracts were received from ten sources indicating the continued interest in herbicide treatment for weed control in legume crops. Twenty-two abstracts were related to small seeded legumes, nine were related to large seeded legumes, and four were concerned with the use of chemicals as defoliants.

A. Small seeded legumes.

Eleven abstracts were concerned with herbicide treatments of seedling stands of legumes. Of these, 9 were related to alfalfa, 6 to red clover, 5 to sweet clover, 2 to lespedeza, and 1 to alsike clover. The herbicides included several formulations of 2,4-D and MCP, TCA, IPC, KCN, 2,4,5-T and DNOSBP.

MCP and 2,4-D at 1/4 pound caused little, if any, damage to alfalfa,, red clover, or alsike clover that was grown with a companion crop. This was also true in many cases for 1/2 pound applications. Injury to the legumes was generally less when the companion crop was six inches or more in height. Sweet clover, as in past years, was generally more susceptible than other legumes to MCP or 2,4-D; however, one worker found sweet clover to be more tolerant than alfalfa at very early stages of growth. Studies at one location found 2,4-D acetanalide to be superior to other forms used as a pre-emergence treatment on alfalfa and sweet clover. Rates as high as three pounds per acre did not injure these crops and gave considerable weed control. Another worker found that satisfactory stands of red clover and lespedeza could be obtained in grass sod by seeding 10 days after 2 pound applications of 2,4-D. Little difference could be noted between the salts of 2,4-D and MCP; however, two workers indicated slightly less injury to legumes from MCP. Lespedeza was found to be quite tolerant of 2,4-D at rates up to 1/2 pound after the plants were 4-6 inches tall and before bloom stage.

Five abstracts dealt with the use of TCA on legumes. Four of these indicated alfalfa and sweet clover to have considerable tolerance to TCA; the other indicated injury to these crops with rates varying from 5 to 20 pounds when applied before the legume emerged. Minnesota workers found no injury to alfalfa and only slight injury to sweet clover with 10 pounds of TCA. Alsike and red clovers were severely injured by 5 pound applications.

Single reports were received on KCN, IPC, 2,4,5-T, and DNOSBP. KCN at rates varying from 5 to 20 pounds pre-emergence did not affect alfalfa, sweet clover or pigweed. IPC at 4 and 8 pounds post emergence did not damage alfalfa, red clover or weeds, except for slight burning. 2,4,5-T at 1 pound killed lespedeza at all stages of growth. DNOSBP, ammonium salt, at 3/8 pound with 3 gallons of fuel oil did not injure red clover, alsike clover, sweet clover or alfalfa.

In one trial, a limited number of varieties of alfalfa, red clover, and sweet clover were treated with three different herbicides in an attempt to find varietal differences. Some varietal response was observed, indicating varietal differences may exist in these legumes.

Eleven abstracts from four sources dealt with the use of herbicides on established stands of legumes. The herbicides included DNOSBP, DNOC, TCA, IPC, and several formulations of 2,4-D and MCP. The legumes included red, alsike, ladino, and sweet clovers and alfalfa. Alfalfa was studied most extensively, being involved in 9 reports. Red clover was mentioned in three, and single reports were received on alsike, ladino and sweet clovers.

Forage and seed yields were retarded considerably by both 2,4-D and MCP when applied to alfalfa that had made considerable top growth. The ester formulations of both products caused more damage than the amine or sodium salts. As salts, MCP was slightly more promising than 2,4-D at rates of 1/4 pound or less. Two workers found alfalfa, with only a very small amount of top growth (early in the spring or after cutting), to be only slightly damaged at these rates. Sweet clover was damaged considerably by all rates of 2,4-D or MCP. Red clover, ladino clover and alsike clover were reported to be relatively tolerant to MCP and 2,4-D at rates up to 1/2 pound. Forage and seed yields of alfalfa were only slightly reduced with good weed control at rates of 4.5 quarts of DNOSBP and 4 quarts of DNOC. Recovery of the alfalfa was complete by fall.

Alfalfa, ladino clover, and sweet clover was found to be quite tolerant of TCA at rates of 5 and 10 pounds applied early in the spring or following cutting. Red and alsike clovers were badly damaged at these rates. Setaria was satisfactorily controlled, particularly at the higher rate. Ohio workers, in attempts to control quackgrass and Johnson grass in alfalfa with TCA report considerable variation in response to different dates of application. Late fall applications resulted in higher alfalfa survival and poorer control of grass. Rates sufficiently high to control the grass species generally caused considerable damage to alfalfa. Their results indicate that alfalfa that appears to recover in the fall may be more subject to winter injury than untreated alfalfa.

B. Large seeded legumes.

Four abstracts were concerned with post emergence applications of herbicides to large seeded legumes. In the one report on soybeans, rates of 2,4-D and MCP as low as 1/16 pound reduced hay yields by 10 percent. CMU, rates as low as 1/2 pound, was quite toxic to soybeans. DNOSBP, alkanolamine salt, at rates of 1/2, 1 and 2 pounds caused burning of leaves but yields were not reduced except at the highest rate.

Extensive trials on canning peas were reported from one station. Eight 2,4-D formulations at rates of 1/16, 1/4 and 1/2 pounds were used in one trial, these included 6 amine salts, a sodium salt and an acid of 2,4-D. Yields were reduced by all treatments except 1/16 pounds as the sodium salt and acid of 2,4-D. The sodium salt and acid of 2,4-D were clearly less toxic to peas than the amine salts. No difference between the amine salts of 2,4-D was observed. In another trial, two amine salts, a sodium salt, and anester of MCP were compared to an amine salt of 2,4-D. The rates used were the same as mentioned above. The 1/16 and 1/4 pound applications of amine and sodium salts of MCP did not reduce pea yields. All rates of the ester of MCP and 1/4 and 1/2 pound rates of 2,4-D reduced yields. The addition of a wetting agent to an amine salt of 2,4-D considerably increased the damage to peas, whereas the addition of a sequestering material did not alter the response.

Rather extensive pre-emergence trials on soybeans were reported in five abstracts from four sources. The herbicides included DNOSBP, PCP, CMU, Endothal, Chloro IPC, Eh#1, and several 2,4-D and MCP formulations. Of these herbicides at the rates used, only DNOSBP, PCP, and Chloro IPC appear to have much promise for pre-emergence weed control in soybeans. The DNOSBP, amine salt, gave the most consistent good results at rates of 6 to 8 pounds per acre. PCP, phenol and sodium salt, was used at rates varying from 8 to 28 pounds per acre. The response was erratic but some good results were obtained at the higher rates. Chloro IPC at rates of 4 to 6 pounds per acre gave promising control of annual grasses with only slight injury to soybeans. CMU, rates of 1/4 to 4 pounds, gave promising weed control but did not appear to be selective. The 2,4-D and MCP formulations generally produced serious injury to soybeans. One worker reported 60 percent control of giant ragweed without serious injury to soybeans using 1.5 pounds of these materials on heavy river bottom soil. Endothal was generally ineffective, while EH#1 usually caused severe injury to soybeans.

C. Defoliants.

Four reports from two stations were concerned with the use of defoliants. Three trials on soybeans and 1 on red clover seed fields were reported. The chemicals applied to soybeans were sodium mono-chlorate, sodium chlorate-borate mixture, sodium cyanamid, and several penta chloro-phenol and dinitro preparations. Of these, sodium cyanamid, 8 percent penta chlorophenol in oil, 40 percent penta chlorophenol in oil, and dinitro in oil gave excellent control of weeds without apparent injury to nearly mature soybeans. DNOSBP, PCP, and sodium mono-chloroacetate were applied to red clover seed fields. DNOSBP (Phenol) at 1.2 pounds and PCP (Phenol) at 6 pounds in 5 gallons of fuel oil applied in a water emulsion at 25 gallons per acre resulted in rapid burning and drying of green vegetation. Five gallons of fuel oil was as satisfactory as more oil, likewise, the 25 gallon volume was as good as higher volumes. Sodium mono-chloroacetate was less satisfactory on red clover than the DNOSBP or PCP.

Abstracts of Results of Cooperators

Small seeded legumes

Project III. Soybeans, Peas, and Leguminous Forages

Control of annual weeds in first year seedings by mowing and herbicides after oat harvest. Dunham, R. S. and R. G. Robinson. This study included control methods for weeds in a 5 inch oat stubble in which there were legume and grass seedlings. Plots of alfalfa-brome, red clover-timothy, alsike clover-timothy, and sweet clover were sown with oats in 1950. Mowing 3 times after oat harvest was compared with no mowing. Also, the following herbicides were compared on mowed and unmowed areas: 2,4-D, amine at 4 oz. per acre, MCP amine at 4 oz., TCA at 4.4 and 8.8 lbs., 2,4-D at 4 oz. plus TCA at 4.4 lbs., and DNOSBP ammonium salt at 3/8 lb. plus 3 gals. of No. 2 range oil. Rates of 2,4-D, MCP, and TCA are on the basis of acid equivalents and were applied in 20 gallons of water.

Mowing was unsatisfactory for the control of Setaria spp. The stand of sweet clover in 1951 on the mowed plots was greatly reduced. Stands of alfalfa-brome, red clover- timothy and alsike-timothy were practically unaffected by mowing.

Sweet clover was severely injured by all herbicides except TCA at 4.4 lbs. and DNOSBP. Red clover and alsike clover were eliminated by TCA. The red clover stand in 1951 was reduced by 2,4-D, and stands of both red clover and alsike clover were unaffected by the other herbicides. Stands of alfalfa, timothy, and brome grass were unaffected by any herbicide. The effect of herbicides on the 1951 stands of legumes was not influenced by mowing. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2757, Sci. Jour. Series, Minn. Agr. Exp. Station).

Effect of 2,4-D, 2,4,5-T and M.C.P. on Annual Lespedeza. Elder, W. C. and J. E. Gassaway. Rates and chemicals used in this test were 1/4, 1/2 and 1 lb. 2,4-D (amine), 1 lb. M.C.P. and 1 lb. 2,4,5-T (amine) per acre. These chemicals were applied on Korean lespedeza at 6 stages of growth. Each plot consisted of 4 rows spaced 1 ft. apart and the center 2 rows were sprayed, using 40 gal. water per acre. The first treatment was made when the lespedeza was small (2 weeks old); the other treatments were spaced 18 to 21 days apart. The 6th treatment was made just before bloom period. Most of the young lespedeza was killed in the first application by all treatments except the 1/4 lb. 2,4-D. After the lespedeza was 4 to 6" high, 1/4 and 1/2 lb. 2,4-D rates had little effect on the forage yield until the 6th or prebloom stage. These treatments delayed growth a few days but the lespedeza quickly recovered. Many of the leaves dropped after the 6th treatment and the plants did not recover and produce more leaves in this advanced stage of growth. This caused stemmy forage with few leaves. 1 lb. 2,4-D (amine) and 1 lb. M.C.P. per acre reacted very much the same for all treatments. All the young lespedeza was killed and all other stages of growth were severely affected at these heavy rates. 1 lb. 2,4,5-T (amine) per acre treatments completely killed lespedeza in all stages of growth. After 3 years of this study, it is concluded that annual lespedeza is somewhat resistant to 2,4-D up to 1/2 lb. rate, providing treatments are made on rapidly growing plants 4" to 6" high. (Contribution of the Agronomy Department, Oklahoma Experiment Station, Stillwater, Oklahoma).

Toxicity of 2,4-D residues to seedling legumes drilled in previously sprayed short bluegrass sod and small grain. Hansen, J. R. and J. F. Freeman. Dense bluegrass sod was raked and clipped and herbicidal applications were made on April 20, 1951 to the sod and an adjacent area with winter wheat, about 12 inches tall, drilled in 7 inch rows. Rates of 2 pounds per acre of the check ester of 2,4-D and the check low volatile ester of 2,4-D and 0.5 pound of the alkanolamine salt of 2,4-D with a 12.5 gallon per acre volume were used as in control of wild garlic with the heavier rate and more sensitive weeds with the lighter. Treatments, including check plots, were duplicated on both sod and grain. Starting April 21 and after each consecutive 5 day period, 1 gram of red clover and Korean lespedeza were planted in 3 foot strips on all plots for 5 dates of planting. Method of planting simulated disk drilling. Final stand or survival counts were made June 20. The average stands for both species on the two ester treatments stated as percent of the untreated checks for consecutive planting dates were 57, 94, 74, 90, and 90 in the sod and 0.2, 5, 34, 34, and 66 in the small grain. For the 0.5 pound amine treatment, stands were 61, 85, 69, 103, and 189 in sod and 7, 71, 78, 139, and 88 in the small grain. Thus, good stands were obtained in all treated sod plots very shortly after application, while normal stands did not appear in the small grain until 20 days after treatment with the 2 pound rates. By coating the seeds with activated carbon, satisfactory stands were obtained in the small grain with the ester application after 10 days. (Kentucky Agricultural Experiment Station).

The effect of herbicides on legumes sown with flax. Miller, J. H. and R. S. Dunham. Alfalfa and red clover seeded with flax were sprayed with 2,4-D (triethanolamine salt), MCP ("Weedar"-amine), TCA and IPC (emulsified). The rates used were 1/2 and 1/4 pounds 2,4-D and MCP; 10.6 and 5.3 pounds of TCA; and 8 and 4 pounds of IPC. All rates of 2,4-D, MCP and TCA are based on acid equivalents and were applied in 40 and 10 gallons of solution when the flax was about 6 inches tall.

Both alfalfa and red clover were only slightly injured by 2,4-D and MCP. In a comparison of 2,4-D and MCP, the MCP was slightly less damaging to both the legumes and weeds. Red clover was injured severely by both rates of TCA, while alfalfa showed no injury. Neither alfalfa nor red clover was appreciably injured by IPC.

Stands of annual grasses were materially reduced by TCA; an estimated 80 to 90 percent for 10.6 pounds and 50 percent for 5.3 pounds. Both 2,4-D and MCP gave satisfactory control of broadleaf weeds. IPC was completely ineffective in controlling the grass weeds. Ten gallon applications were generally less injurious to the legumes than 40 gallon applications of 2,4-D and MCP. Little difference between volumes could be observed for TCA. Flax was severely injured by IPC at both rates but showed little or no injury from the other herbicides. (Contribution of Div. of Weed Investigations, BPIS&AE, U.S.D.A. and Minn. Agri. Exp. Sta.) Paper No. 2739. Sci. Jour. Series of Minn. Agri. Expt. Sta.

The effect of herbicides on legumes sown with oats. Miller, J. H. and R. S. Dunham. Alfalfa, alsike clover and red clover were sprayed with a triethanolamine salt of 2,4-D, an amine salt of MCP (Weedar MCP) and the sodium salt of TCA. The rates used were: 1/2 and 1/4 pounds, acid equivalent per acre for the 2,4-D and MCP, and 10.6 and 5.3 pounds, acid equivalent, per acre for the TCA. Applications were made when the oats were about six inches tall and on other plots when the oats were fully headed (15 inches tall). The legumes were 1 - 3 inches and about 6 inches tall at the respective dates of application.

No difference between dates of application could be observed on the legumes indicating that perhaps increased weed and oat competition at the late date off-set any increased damage due to herbicides that may have occurred at the earlier date. None of the legumes was importantly damaged by the amine salt of MCP, although slight injury to alsike resulted with the 1/2 pound rate. Red clover was not injured by the amine salt of 2,4-D, but both alfalfa and alsike were moderately damaged. Little difference could be observed between rates of application. Alfalfa was not injured by TCA, red clover was moderately injured, and the injury to alsike was severe. No reduction in oat stand could be observed with these rates of TCA while the annual grass control was estimated to be 85 to 90 percent for 10.6 pounds and 50 percent for 5.3 pounds. The control of broadleaf weeds was estimated to be 85 percent for 2,4-D compared to 75 percent for MCP. (Contribution of Div. of Weed Investigations, BPS&AE, U.S.D.A. and Minn. Agricultural Experiment Station, Division of Agronomy and Plant Genetics). Paper No. 2736. Sci. Jour. Series of Minn. Agri. Expt. Sta.

Varietal response of legumes to herbicides. Miller, J. H. and R. S. Dunham. Replicated single-row cultivated plots of varieties of alfalfa, red clover, and sweet clover were sprayed with a triethanolamine salt of 2,4-D, an amine salt of MCP (Weedar MCP), and the sodium salt of TCA. The rates used were 1/2 and 1/4 pounds, of acid equivalent per acre for 2,4-D and MCP, 10.6 and 5.3 pounds of acid per acre for TCA. Applications were made using volumes of 40 and 10 gallons of solution per acre when the alfalfa and sweet clover were about 6 inches tall and the red clover 3 to 4 inches tall. The varieties included were: alfalfa-- Cossack, Grimm, Ranger, and Ladak; sweet clover -- Evergreen, Madrid, Commercial Late White and Commercial Yellow; red clover -- Wegener, Midland, Northern Commercial, and Wisconsin Mildew Resistant.

None of the alfalfa varieties was injured by TCA. All alfalfa varieties were slightly injured by 2,4-D; Grimm being injured the most. Cossack and Ranger were not injured by the 1/4 pound of MCP. All alfalfa varieties were slightly injured by 1/2 pound of MCP, the injury being most severe on Ladak.

All of the red clover varieties were injured by both rates of TCA. Wegener and Wisconsin Mildew Resistant were somewhat less tolerant than the other varieties. All varieties of red clover were injured only slightly by 2,4-D and MCP, varietal difference was not apparent. Red clover was slightly more tolerant to MCP than to 2,4-D.

The sweet clover varieties were not injured by 5.3 pounds of TCA. With 10.6 pounds, all varieties were slightly injured with Evergreen being injured most. All sweet clover varieties were badly injured by 1/2 pound of 2,4-D and MCP, but injury at 1/4 pound was considered slight. No varietal difference was apparent for 2,4-D or MCP.

There was no practical difference between the 40 and 10 gallon applications on any legume. (Contribution of Div. of Weed Investigations, BPIS&AE, U.S.D.A. and Minn. Agri. Exp. Sta.) Paper No. 2737. Sci.Jour.Ser.,Minn. Agri.Expt.Sta.

Effect of different herbicides on alfalfa, sweet clover and Russian pigweed, treated pre-emergence. 1951. Pavlychenko, T. K. Plots of alfalfa (Medicago sativa), sweet clover (Melilotus officinalis) and Russian pigweed (Axyris amaranthoides) were treated prior to emergence with TCA and KCN at 5, 10, 15, and 20 lbs./a.; amine of MCP (Weedar MCP) at 1/2, 3/4, 1, 1 1/2, and 2 lbs./a.; acid of 2,4-D (ACP472) at 1, 2, and 3 lbs./a.; acetanalide of 2,4-D (ACP646A), and a mixture of 2,4-D and 2,4,5-T (ACP926). The soil was silty clay loam and growing conditions were favorable. RESULTS: TCA did not prevent alfalfa and sweet clover from emerging, although their stand and vigor were reduced quite severely. Russian pigweed was prevented from emerging in only one plot and its vigor was seriously impaired in the remaining plots of TCA. Weedar MCP prevented alfalfa and sweet clover from emerging at 1 and 2 lbs./a. and caused some retardation in their development with the remaining rates. Russian pigweed was eliminated by all rates, except 3/4 lb./a., which reduced its stand and vigor very seriously. ACP472 prevented the emergence of clover and alfalfa at 3 lbs./a. but at 1 and 2 lbs./a., they developed almost normally. Russian pigweed reacted similarly. ACP646A at all rates had no appreciable effect on alfalfa and sweet clover, while Russian pigweed was seriously retarded. ACP926 and KCN, at all rates, caused little or no reduction in the stand and vigor of each of the three species. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Response of alfalfa, sweet clover and wild mustard to systemic herbicides. 1951. Pavlychenko, T. K. Replicated plots of alfalfa (Medicago sativa), sweet clover (Melilotus officinalis) and wild mustard (Brassica arvensis) were established this spring and treated with low volatile ester of 2,4-D (Weedone LV4) at rates of 2, 4, and 8 oz./a., and with amines of 2,4-D (Weedar 64 and ACP127) at rates of 4 and 6 oz./a. At the time of treatment, the alfalfa was in the 4 leaf (1") stage, sweet clover in the 2-3 leaf (1 1/2") and wild mustard was in the 4-5 leaf (2") stage. RESULTS: All rates of Weedone LV4 caused a depression in the vigor and height of alfalfa, with the reductions in the dry weight being 20, 28, and 22 percent for the 2, 4, and 8 oz./a. rates respectively. Similar figures for sweet clover were 0, 0 and 31 pct. Weedar 64 produced some depression in the vigor of alfalfa and reduced the dry weight by 10 and 11 pct. at the 4 and 6 oz./a. rates respectively. Sweet clover was affected only at the 6 oz./a. rate, with a reduction in dry weight of 21 pct. ACP127 appeared to be less severe on alfalfa than on sweet clover, causing only 2 and 11 pct. reductions in dry weight at the 4 and 6 oz./a. rates in alfalfa, whereas on sweet clover, it caused a reduction of 13 pct. at both rates. Wild mustard was completely eliminated with every treatment except Weedone LV4 at the 2 and 4 oz./a. rates, where 7 and 5 pct. of drpressed mustards survived. In the fall, both legumes had fairly uniform and well established stands of normal vigor. This work seems to indicate that in spite of some initial injuries caused by some of the chemicals used, the treatments were definitely beneficial to their establishment under prairie conditions. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Response of alfalfa, sweet clover and wild mustard to amine of MCP. 1951. Pavlychenko, T. K. Replicated plots of alfalfa (Medicago sativa), Sweet clover (Melilotus officinalis) and wild mustard (Brassica arvensis) were treated with amine of MCP (Weedar MCP) at rates of 2, 4, and 6 oz./a., at three different growth stages: on July 17th, when the alfalfa, sweet clover and wild mustard were at the 4 (1"), 2-3 (1 1/2") and 4-5 (2") leaf stages respectively; on July 25th at the 5-6 (2 1/2"), 5 (3 1/2") and 7 (6") leaf stages, and on Aug. 2nd at the 6-8 (4"), 7-8 (6") and flowering (15") stages.

RESULTS: The July 17th treatment gave reductions in the dry weight of alfalfa of 15, 0, and 54 pct. at the 2, 4, and 6 oz./a. rates respectively. Sweet clover was affected to a lesser extent, the respective reductions in dry weight being 0, 10, and 28 pct. The July 25th treatment had a negligible depression on alfalfa with the reductions being 0, 3, and 7 pct. at the 2, 4, and 6 oz./a. rates respectively. Sweet clover was affected to a greater extent and the respective reductions were 36, 11, and 12 pct. The Aug. 2nd treatment appeared to be the most severe on both alfalfa and sweet clover; alfalfa was reduced 45, 37, and 41 pct. and sweet clover was reduced 75, 45 and 64 pct. in dry weight respectively, accompanied by rather severe epinasty and injury. Wild mustard was completely eliminated by all rates of MCP, in all three treatments. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

EFFECT of selective herbicides on alfalfa in oats and flax as nurse crops. 1951. Pavlychenko, T. K. Replicated plots of newly seeded alfalfa (Medicago sativa), were established in oats (Avena sativa) and flax (Linum usitatissimum) as the nurse crops, previously thickly infested with wild mustard (Brassica arvense) to simulate conditions in weedy fields. When the mustard, flax, oats and alfalfa plants were 6, 5, 8, and 1 to 2 inches high, respectively, the plots were treated with amine salt of MCP (Weedar MCP) and amine of 2,4-D (Weedar 64), at 2, 4, and 6 oz./a. rates and with low volatile ester of 2,4-D (LV4) at 2, 4, 6, and 8 oz./a. rates. The primary purpose in this work was to secure experimental evidence of the degree of susceptibility or resistance of the young alfalfa plants to treatments with the above materials of lower volatility. The effects of these chemicals on the nurse crops and on wild mustard were also noted. RESULTS: Under protection of the nurse crops and mustard, the small alfalfa plants looked quite healthy and normal after the treatment. They remained small until the nurse crops were cut. This retardation was mainly due to the very strong competition of the nurse crops and only partially to the chemical treatments. The effect of chemicals on alfalfa was also shown by a slight reduction of its stand (5 pct. at the highest rate, 8 oz./a of LV4). The high pct. of survival in alfalfa stand was general and of the greatest importance in this work. Wild mustard was quite well controlled even at the lowest rates of all the chemicals used. The yields of oats and flax were significantly increased, sometimes doubled, due to the effective elimination of the wild mustard competition. (Contributed by Agr. Div., American Chemical Paint Co., Saskatoon, Sask.)

Yields of alfalfa-clover mixtures sown in 2,4-D-treated oats. Willard, C. J. and R. L. Bernard. Hay (alfalfa-clover, no grass) was harvested on these plots, treated in 1950 with the iso-propyl ester of 2,4-D (Research Report, 1950, page 69). The untreated (27 plots) yields averaged 5170 pounds per acre. As an average of all dates (27 plots each rate) the hay yields per acre averaged: 1/4#/A., 5050 lb.; 1/2#, 4870; 1#, 3590; 2#, 2260; 4# 1250. The first two post-emergence applications (oats 2" and 6" to 8" tall) reduced the yield of hay most. In general, the injury decreased as the oats were larger at time of spraying, until at the milk stage, 4 lb./A. of 2,4-D ester permitted an average yield the next year of 3650 lb./A. of alfalfa-clover hay. At rates recommended for weed control, the range of hay yields on different dates was (for average of 3 plots) for 1/4#/A., 4270 to 5580 lb.; for 1/2#/A., 4430 to 5440 lb. At the recommended full tiller stage, the yields were not reduced below the checks by 1/4 or 1/2# 2,4-D per acre. This is contrary to our previous experience, but illustrates that treating small grain with 2,4-D does not necessarily destroy the legumes sown in them. There was more or less alfalfa in all plots - attempts to rate the two crops separately failed. Ohio Agricultural Experiment Station.

Pre-emergence use of 2,4-D on alfalfa. Bolton, J. L. and R. T. Coupland. Pre-emergence treatments on a field scale were applied to mature stands of alfalfa at Pas Trail, Sask. The rates used were 4 oz. of 2,4-D ester and 8 and 10 oz. per acre of 2,4-D amine. Applications were made May 4 when the alfalfa was 1 to 3 inches high, or very shortly after new growth appeared. The treated alfalfa showed some effects from the 2,4-D but recovered. At flowering time, there was no apparent difference in maturity between treated and untreated strips. No difference in seed yield was apparent. Complete or practically complete control of Russian pigweed (Axyris amaran hoides) and lamb's-quarters (Chenopodium album) was obtained from all treatments. (Contribution from the Department of Plant Ecology, University of Saskatchewan and the Dominion Forage Crops Laboratory, Saskatoon).

Effect of herbicides on dandelion in alfalfa. Bolton, J. L. and R. T. Coupland. A 9-yr. old alfalfa field at Prince Albert, Sask. was treated with several herbicides at two stages, May 26 and June 12 when height of alfalfa averaged 11 and 15 in., respectively. Dandelion was in the rosette stage. 2,4-D and MCP were applied by a wheel-mounted, hand-powered sprayer, delivering 7.1 gal. per acre. Dinitros were applied by a knapsack sprayer in 75 gal. of water per acre. By July 13, damage to weeds (expressed in terms of reduction of green foliage below checks) was 75% or more from the following treatments: 8 oz. of 2,4-D amine, 2, 4, and 8 oz. of 2,4-D (butyl ester), 15 oz. of MCP (sodium salt), 6, 8, and 10 oz. of MCP (butyl ester) in the first stage; and 8 oz. of 2,4-D ester, 12 and 15 oz. of sodium salt and amine of MCP, 8 and 10 oz. of butyl ester of MCP, and 2.2, 4.5 and 9.0 qt. of DNOSBP (ammonium salt - Dow Selective) in the second stage. 35 to 70% damage was caused by the following: 9 and 12 oz. of MCP sodium salt, 6, 9, 12, and 15 oz. of MCP amine, 2 and 4 oz. of MCP ester, 4.5 and 9 qt. of DNOSBP in the first stage; and 4 and 8 oz. of 2,4-D amine, 4 oz. of 2,4-D ester, 9 oz. of MCP sodium salt, 3, 6, and 9 oz. of MCP amine, 4 and 6 oz. of MCP ester, 4 qt. of DNOC (sodium salt - Sinox) in the second stage. Damage was 30% or less from the following: 2 and 4 oz. of 2,4-D amine, 3 and 6 oz. of MCP sodium salt, 3 oz. of MCP amine, 2.2 qt. of DNOSBP, and 1, 2, and 4 qt. of DNOC in the first stage; and 2 oz. of 2,4-D amine, 2 oz. of 2,4-D ester, 3 and 6 oz. of MCP sodium salt, 2 oz. of MCP ester, 1 and 2 qts. of DNOC in the second stage. Recovery was sufficient by Sept. 20 so that no appreciable effect of any treatment was observable at that time. The effect on alfalfa was such that the most promising treatments of those tested for dandelion control in alfalfa for forage would be 3 oz. of MCP amine in the first stage and 2.2 to 4.5 qt. of DNOSBP and 4 qt. of DNOC in the second stage. For control in alfalfa seed fields, 2.2 to 4.5 qt. of DNOSBP and 4 qt. of DNOC in the second stage were most promising. (Contribution of the Department of Plant Ecology, University of Saskatchewan and the Dominion Forage Crops Laboratory, Saskatoon, Sask.)

Effect of dinitro compounds on alfalfa. Bolton, J. L. and R. T. Coupland. Field treatments of DNOSBP (ammonium salt - Dow Selective Weed Killer) were applied on a mature stand of alfalfa at Pas Trail, Sask. Rates were: 2.5 and 3.5 quarts per acre applied when the alfalfa was about 10 inches high on July 8. A light rain followed about 1 hour after application. Russian pigweed (Axyris amaranthoides) and lamb's quarters (Chenopodium album) wilted after treatment but recovered. The alfalfa was unaffected. It is thought that relatively low temperatures and rain accounted for the lack of control. (Contribution from the Department of Plant Ecology, University of Saskatchewan and Dominion Forage Crops Laboratory, Saskatoon).

Effect of dinitros on alfalfa seed fields. Coupland, R. T. and J. L. Bolton. DNOC (sodium salt - Sinox) and DNOSBP (Ammonium salt - Dow Selective Weed Killer) were applied to a 9 yr. old stand of Grimm alfalfa at Prince Albert, Sask. at two stages of development. Stage 1, on May 26 when the alfalfa was 8 to 14 inches high; stage 2, on June 12 when the alfalfa was 10 to 20 inches high. Application was made to duplicated plots of 1/80 acre each by a knapsack sprayer in 75 gallons of water per acre. Rates of treatment were 2.2, 4.5 and 9.0 qt. of DNOSBP and 1, 2, and 4 qt. of DNOC per acre. On July 13 no damage to the alfalfa could be seen from treatment at the first stage, and from 2.2 qt. of DNOSBP and 1 and 2 qt. of DNOC. Foliage was reduced by 5 percent by 4.5 qt. of DNOSBP and 4 qt. of DNOC and by 25 percent by 9 qt. of DNOSBP. By Sept. 20, recovery appeared to be complete as far as forage yield is concerned. Seed yield was unaffected by all treatments except the 4.5 and 9 qt. of DNOSBP in stage 2 which reduced it by about 5 and 40 percent, respectively. In the second stage of treatment, 2.2 and 4.5 qt. of DNOSBP and 4 qt. of DNOC gave considerable control of weeds (dandelion) without serious damage to forage or seed yield of alfalfa. (Contribution of the Department of Plant Ecology, University of Saskatchewan and the Dominion Forage Crops Laboratory, Saskatoon, Sask.)

Effect of 2,4-D on alfalfa seed fields. Coupland, R. T. and J. L. Bolton. 2,4-D ester (Green Cross butyl) and amine (a mixture - Naugatuck) were applied to a 9 yr. old field of Grimm alfalfa at Prince Albert, Sask. at two stages of development. Stage 1, on May 26 when alfalfa was 8 to 14 inches high; stage 2, on June 12 when the alfalfa was 10 to 20 in. in height. Application was made with a hand-powered wheel sprayer in 7.1 gallons of solution per acre to duplicated plots of 1/80 acre. Notes taken on July 13 indicated that damage to alfalfa (as expressed in terms of reduction of forage yield below check) was severe from all treatments, being 75 to 100 percent with the 4 and 8 ounce rates of both herbicides, about 60 percent from 2 oz. of ester, and 45 to 50 percent from 2 oz. of amine. The two dates of treatment were approximately equal in effect on alfalfa. By Sept. 20, considerable recovery had taken place so that the reduction was 85 to 90 percent with the highest rate of ester (8 oz.), 50 percent from 4 oz. of ester, 30 to 40 percent from 2 oz. of ester and 8 oz. of amine, and 10 to 20 percent from the 2 and 4 oz. rates of amine. Recovery was approximately the same from both stages of treatment. Seed production was affected more than forage yield, especially by the second treatment (June 12). Reduction in seed yield was 90 to 100 percent by ester at 8 oz. in stage 1 and all rates of ester in stage 2, 65 to 90 percent by 4 and 8 oz. of ester and 8 oz. of amine in stage 1 and by all rates of amine in stage 2, and 30 to 40 percent by 2 and 4 oz. of amine in stage 1. 2,4-D does not seem promising for control of weeds in alfalfa at the stages tested. (Contribution of the Department of Plant Ecology, University of Saskatchewan and Dominion Forage Crops Laboratory, Saskatoon, Sask.)

Effect of MCP on alfalfa. Coupland, R. T. and J. L. Bolton. MCP as the sodium and amine salts at 3, 6, 9, 12, and 15 oz. per acre and as the butyl ester at 2, 4, 6, 8 and 10 oz. per acre was applied to a 9 yr. old stand of Grimm alfalfa near Prince Albert at two stages. Stage 1, May 27 when alfalfa was 8 to 14 inches high; stage 2, June 12 when alfalfa was 10 to 20 in. in height. Duplicated plots of 1/80 acre each were treated by a hand-powered wheel sprayer delivering 7.1 gal. per acre. Damage to alfalfa by July 13 (expressed in terms of reduction of forage yield below check) was severe, particularly in the second stage. Damage was 45 to 100% from all treatments in the second stage and from all except the 3 and 6 oz. rates of sodium and

amine salt and 2 oz. of ester in the first stage. The latter treatments caused 20 to 40% damage. Recovery by Sept. 20 was good at the lower rates. Forage yield was reduced by 40 to 90% by the 15 oz. rate of sodium salt and 12 and 15 oz. rate of amine in stage 2 and by 4 to 10 oz. of ester in both stages. 10 to 35% damage occurred from 2 oz. of ester, 6 and 9 oz. of amine and 3 to 12 oz. of sodium salt in stage 2 and from 2 oz. of ester and 9 to 15 oz. of amine and sodium salt in stage 1. Slight damage was apparent from the 6 oz. amine treatments in stage 1 and complete recovery had been made from the 3 oz. amine treatments in both stages and the 3 and 6 oz. sodium salt treatments in stage 1. Damage to seed yield was much greater from the second stage of treatments and was reduced 25 to 100% by all treatments except the following in stage 1: 2 oz. of ester (10%), 3 and 6 oz. of amine (10%) and 3 and 6 oz. of sodium salt (0 to 5%). The 3 oz. rate of amine of MCP applied in the early foliage stage provided considerable control of weeds (dandelion) without serious damage to the forage or seed production of alfalfa. (Contribution of the Department of Plant Ecology, University of Saskatchewan and the Dominion Crops Laboratory, Saskatoon, Sask.)

The effect of herbicides on established legumes. Miller, J. H. and R. S. Dunham. Established stands of alfalfa, sweet clover, red clover, and ladino clover were sprayed with 2,4-D (triethanolamine salt) MCP ("Weedar" amine salt), TCA (sodium salt) and IPC (emulsified). The rates used were 1/2 and 1/4 pounds acid equivalent for 2,4-D and MCP; 10.6 and 5.3 pounds acid equivalent for TCA; and 8 and 4 pounds of IPC. Applications were made in the early spring (alfalfa 4 inches tall) and on other plots immediately after the first hay crop was removed.

At the first date of application, the alfalfa stand was reduced 25% by 1/2 pound of 2,4-D and MCP. Injury with 1/4 lb. was very slight, if any. Sweet clover stands were practically eliminated by both rates of 2,4-D and MCP. Red, alsike, and ladino clovers were not injured by 2,4-D and MCP. Alfalfa, sweet clover and ladino clover were not damaged by TCA. Red and alsike clovers were badly damaged by TCA, the injury to alsike being most severe. None of the legumes was injured, except for slight burning, by the IPC. 2,4-D was superior to MCP for the control of broadleaf weeds (ragweed, marsh elder, lambsquarters, and pigweed). TCA reduced Setaria stands by 85 to 90% with 10.6 pounds and 50% with 5.3 pounds. IPC gave no weed control.

At the second date of application, none of the legumes except sweet clover was injured by any of the herbicides. Sweet clover was practically eliminated by both 2,4-D and MCP but the original stands were thin. TCA produced slight crinkling of leaves on red clover and alsike clover but this effect disappeared after a short time and no permanent injury could be ascertained. The moving of the hay crop controlled the broadleaf weeds so that the effect of 2,4-D and MCP could not be measured. TCA reduced the stand of Setaria but was not as satisfactory as at the earlier date. (Contribution of Div. of Weed Investigation, BPISAE, U.S.D.A. and Minn. Agri. Exp. Sta.) Paper No. 2738 of Sci. Jour Series of Minn. Agri. Expt. Sta.

Control of quackgrass in established alfalfa using sodium TCA. Peters, R. A. and C. J. Willard. Sodium TCA was applied to an established alfalfa-quackgrass stand on Miami soil at Columbus. Rates of 0, 10, 20, 40 and 80 pounds per acre acid equivalant were applied July 18, October 12, and November 15, 1950 and on April 5, 1951 on plots 14 by 14 feet replicated three times. The July application initially gave complete top kill of quackgrass at

rates of 20 pounds and above with very little damage to the alfalfa. In the spring of 1951, however, the alfalfa density was reduced to 10 percent and 50 percent of the check at the 80 pounds and 20 pound rate respectively. As of September 17, 1951, there was 0, 25, and 75 percent recovery of quackgrass at the 80, 40, and 20 pound rates respectively. In the October application, some temporary effects were noted in the spring of 1951, but by June 7, 1951, no evidence of treatment could be seen in either the quackgrass or the alfalfa. The November application had no effect on either species. The April treatment resulted in a 80-90 percent quackgrass top kill at all rates. However, by August 16, 1951, there was complete recovery at the 10 pound rate. The alfalfa density and height was only slightly decreased at the 10 and 20 pound rate. At the 40 and 80 pound rates, the height of growth decreased one-half and two-thirds respectively although there was little change in density. By August 16, 1951, the alfalfa was normal in all plots except for greater leafhopper damage at the higher rates of TCA. Ohio Agricultural Experiment Station.

Effect of sodium TCA upon an established alfalfa-Johnsongrass mixture. Peters, R. A. and C. J. Willard. Applications of sodium TCA were made on August 29, October 7, November 18, 1950 and on March 31 and June 16, 1951 on a three-year-old alfalfa stand on a Genesee soil near Waverly, Ohio. Rates of 0, 10, 20, 40 and 80 pounds, acid equivalent, per acre in 40 gallons of solution were applied on plots 14 by 30 feet replicated three times. At the time of the first cutting in June, 1951, only the August 1950 and the March 1951 applications showed any treatment effects. On July 4, the percent of alfalfa on plots treated in August 1950 based on hand separation of the mixture was 54, 78, 82, 53 and 13 at rates of 0, 10, 20, 40 and 80 pounds per acre, respectively. The low percentage at the 80 pound rate was due to the heavy stand of Johnsongrass seedlings which came into the nearly bare plots after the death of most of the alfalfa following treatment. At the 10 and 20 pound rates, the alfalfa was normal and the total alfalfa yield was higher. However, August 25, 1951 treatment effects were no longer apparent. The March applications killed over 75 percent of the alfalfa at all rates. Additional applications were made June 16, 1951. On July 4, hand separations showed 58, 77, 86, 91 and 96 percent of alfalfa at rates of 0, 10, 20, 40 and 80 pounds per acre, acid equivalent, of TCA, respectively. There was enough injury to the alfalfa at the two high rates to decrease the total alfalfa yield compared to the check. Following the third cutting, however, the alfalfa was normal at all rates and there was no Johnsongrass at the 40 and 80 pound rates. Ohio Agricultural Experiment Station.

Effect of sodium TCA upon established red clover. Peters, R. A. and C. J. Willard. Sodium TCA was applied on September 1, 1950 on vigorous red clover in the early bloom stage. It had been sown in wheat in the spring of 1950. Rates of 0, 10, 20, 40 and 80 pounds, acid equivalent, per acre were applied in 40 gallons of solution on plots 7 by 60 feet replicated four times. The chemical prevented further floral development, but no vegetative effects were observed on September 18, 1950. Later in the fall, the plots showed severe burning and drying. When observed on May 2, 1951, there was no clover on the plots treated at the 80 and 40 pound rates. At the 20 pound rate, there were a few scattered plants and at 10 pounds, the stand was about 25 percent of the check. Other species were found in all plots including some alfalfa at the 80 pound rate. Powdery mildew on the red clover plants at the time of spraying was no longer visible a few days after the TCA application. Ohio Agricultural Experiment Station.

Control of yellow rocket in established red clover and alfalfa with MCP. Watson, A. J. Alfalfa and red clover hay fields infested with yellow rocket (Barbarea vulgaris) were treated in early spring of 1950 and 1951 when the legumes were still dormant or just breaking dormancy. MCP amine salt, 2,4-D amine salt, and 2,4-D ester at rates of 4 to 16 oz. per acre were used. The weed was removed by the 6 oz. rate of MCP from both crops with only slight stunting of early growth. By the time of first cutting, symptoms of injury had disappeared and there were no signs of injury on subsequent growth. The clover and alfalfa showed less response to 8 oz. of MCP than to 4 oz. 2,4-D amine while MCP was only slightly less active on the yellow rocket. The weed was effectively controlled by all rates of 2,4-D but legumes showed considerable injury. For best results, the treatment had to be applied very early while the legumes were dormant and while the yellow rocket was still in the rosette stage. (The Dow Chemical Co., South Haven, Michigan)

Large seeded legumes

The effect of a wetting agent and sequestering material on the toxicity of 2,4-D to canning peas. Buchholtz, K. P. Commercial preparations of 2,4-D usually contain sequestering materials and may contain wetting agents as well. The addition of these materials may influence the selectivity of the preparation and cause injury to the more susceptible crops. Alaska canning peas were sprayed on June 5 with an isopropylamine preparation of 2,4-D without additive, with 12 percent Igepal as the wetting agent, and with sufficient sequestering material for 1000 ppm of water hardness. In addition, a dimethylamine preparation of 2,4-D was used for comparison. Rates of 0.125, 0.25, and 0.50 0.50 lbs. per acre were used and applications were made in water equivalent to 40 gallons per acre. Four replications were used. At maturity, the plots were harvested, the yields of shelled peas obtained, the tenderometer readings of the peas determined. All applications reduced yields significantly. However, the yields of the plots treated with the preparation containing the wetting agent were much less than those receiving the other treatments. Average yields of shelled peas produced on all plots treated with the preparations containing the wetting agent, the sequestering material, and without additive were 1615, 3624 and 3571 lbs. per acre respectively, while check plots yielded 5170 lbs. No yields of peas were obtained from plots treated with 0.50 lb. of 2,4-D when applied with the wetting agent. There were no significant differences in average yields of plots treated with the preparation containing sequestering material and the ones without additive. Tenderometer readings were reduced significantly by all treatments but the 0.125 lb. of the isopropylamine of 2,4-D. Readings of peas from plots treated with preparations containing the wetting agent additive were substantially lower than those of other comparable treatments. It is evident that the tolerance of peas to 2,4-D was greatly reduced by the presence of wetting agent in the preparations. Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.

Response of canning peas to preparations of MCP and 2,4-D. Buchholtz, K. P. Alaska peas were sprayed on June7 when about 10 inches high, but before bud, with two amine preparations of MCP as well as with sodium salt and ester preparations and with an amine preparation of 2,4-D. Rates of 0.125, 0.25 and 0.50 lbs. per acre were used and treatments were applied in water equivalent to 40 gallons per acre. Four replications were used. At the canning stage, the peas were harvested, yields of shelled peas obtained and tenderometer readings of the peas determined.

The 0.125 and 0.25 lb. applications of the amine preparations and the sodium salt of MCP failed to reduce yields of shelled peas significantly. Plots given these treatments yielded 4333, 3701, 3924, 3738, 4211 and 3998 lbs. per acre respectively while check plots yielded 4192 lbs. All applications of the ester preparation and the 0.25 and 0.50 lb. applications of 2,4-D reduced yields significantly. There were no significant differences among the average yields of all treatments from the plots treated with amine or sodium salt preparations of MCP. Average yields of plots treated with these materials were 3774, 3491 and 3683 lbs. per acre respectively. Tenderometer readings were not affected significantly by the 0.125 lb. applications with the exception of the ester of MCP. Allother treatments reduced tenderometer readings significantly. This reduction indicates a delay in maturity and it is likely that if all plots could have been harvested at comparable tenderometer readings that the reductions in yields noted with the heavier rates of application would have been substantially less. Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.

Response of canning peas to 8 preparations of 2,4-D. Buchholtz, K. P. Alaska peas were treated on June 6, 1951 when about 10 inches high, but before bud, with the isopropyl, dimethyl from two sources, triethyl, diethanol, and triethanol amine preparations as well as the sodium salt and acid preparations of 2,4-D. Applications were made at rates of 0.125, 0.25 and 0.50 lbs. per acre in water equivalent to 40 gallons per acre and 4 replications were used. At the canning stage, the peas were harvested and weights of shelled peas as well as their tenderometer readings were obtained.

Check plots yielded 3656 lbs. of shelled peas per acre. Yields from all plots but those treated with 0.125 lbs. of the sodium salt and acid preparation of 2,4-D were significantly less than check. Plots treated with the two latter treatments yielded 3091 and 3608 lbs. per acre respectively. The average yields of all plots treated with the sodium salt and acid preparations of 2,4-D were 2582 and 2670 lbs. while average yields of plots treated with the amine preparations ranged from 2105 to 1903 lbs. The sodium salt and acid preparations of 2,4-D were clearly less toxic to the peas than the amine preparations. No significant difference in the toxicity of the various amine preparations was observed. Tenderometer readings of the peas were reduced significantly from all plots treated with 0.50 lbs. of 2,4-D except those treated with the sodium salt. The peas from check plots tested III while peas from plots treated with the higher applications of the amine preparations tested as low as 73. This difference in tenderometer reading represents a delay in maturity equivalent to 4 or 5 days. The reductions in yield noted probably would not have been as great if all plots could have been harvested at equivalent tenderometer readings. Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.

Herbicidal tolerance of soybeans to post-emergence sprays. Hansen, J.R. and Freeman, J. F. The control of giant ragweed in soybeans with light applications of 2,4-D has been attempted by growers in the Ohio river bottoms. Some control has been claimed with rates as low as 1/30 pound of 2,4-D per acre. The tolerance of Wabash soybeans was studied in two experiments on upland soil. In one, the alkanolamine salt of 2,4-D, the check ester of 2,4-D, and the check amine of MCP were applied at 1/16, 1/8, 1/4, and 1/2 pounds; and CMU and the alkanolamine salt of DNOSBP were used at 1/2, 1, and 2 pounds. In the other experiment, the check ester was omitted. Herbicides were applied on two dates in both experiments, with the first trifoliate leaf and at the 3-5 trifoliate

leaf stage. Weather conditions were generally favorable for maximum toxicity. In one experiment, harvested at hay stage, MCP and the 2,4-D materials reduced yield at the lowest rate by about 10 percent. While beans seemed more tolerant of MCP at the lowest rate and more sensitive to 2,4-D ester at the highest rate, there were no significant differences between these materials over all rates and dates of treatment. Yields in tons of dry matter per acre over both dates and all rates were 1.04, 1.02, and 1.01 for 2,4-D amine, 2,4-D ester, and MCP respectively. CMU was much more toxic at the first date. At the later date, beans and weeds intercepted much of the spray and toxicity was less to foliage than through the soil. DNOSBP burned leaves initially, but plants recovered so that yield was reduced only at the higher rate. (Kentucky Agricultural Expt. Station).

Herbicides on soybeans. Burt, E. D., Gideon D. Hill, and C. J. Willard. Lincoln soybeans were drilled solid June 14, 1951, in 6' x 25' plots, (8 drill rows plus 16" border) treated June 15. All treatments were applied at 10 gallons solution per acre. A mixture of rape and ryegrass was broadcast from the grass-seed attachment of the drill, to simulate weeds. The herbicides used and results obtained were: DNOSBP, triethanolamine salt (Premerge) 5, 7 1/2, and 10 lb./A. gave excellent results, as in past years. 7 1/2 and 10 gave essentially complete control of grass and broadleaved weeds, without damage to beans. 7 1/2# best practical rate. 5# almost, not quite enough. 3-(p-chlorophenyl)-1, 1-dimethyl-urea (CMU) at 1/4, 1/2, 1, and 2 lb./A. gave some weed control at 2 lb./A. Damage to beans, expressed as chlorosis, stunting, death of some plants, about paralleled weed control, but was later outgrown. Not promising. Endothal at 2 lb./A. was ineffective. Chloro-IPC, used at 1/2, 1, 2, 4, and 8 lb./A. was very effective on grasses at the two higher rates, somewhat effective on broad-leaved weeds, little damage to beans. Worth further trial. PCP, phenol, 8 and 12 lb./A. in diesel oil, had some effect on weeds without injury to beans, but was greatly inferior to DNOSBP. Not worth further trial; too erratic in results. Yields are being taken on this test, but were not available at this time. There is every evidence that there will be no significant differences in yield of any of the plots. Ohio Agricultural Experiment Station.

Pre-emergence weed control in soybeans. Haberman, W. O., R. R. Wangerin, E. S. Roos. Soybeans were planted June 6 and sprayed June 7 with PCP, sodium salt at 20 and 15 lb./A.; PCP, sodium salt combined with chloro-IPC at 10 and 2.5 lb./A. respectively; PCP, sodium salt combined with EH 1 at 10 and 1 lb./A.; Dow Premerge at 3 lb./A.; Premerge combined with chloro-IPC at 3 and 2.5 lb./A.; Premerge combined with EH 1 at 1 1/2 and 1 lb./A.; and MCP, sodium salt at 1 lb./A. Plots were 0.2 acre, triplicated and randomized. Heavy rainfall followed treatments beginning on night of June 7. Spray volume 33 gal./A. All chemicals formulated with water as carrier. Weed counts were made 33 and 54 days after treatments.

PCP at both rates and in combination with chloro-IPC or EH 1 all gave good broadleaf weed control, significantly better than checks and other treatments. Beans showed stunting in all treatments with EH 1. Pre-emergence broadleaf control was observed up to 54 days. Crabgrass was controlled to a certain extent.

Premerge alone and with chloro-IPC were significantly better than check but not as good as PCP alone and in combination.

Neither Premerge plus EH 1, nor MCP , sodium salt showed significant difference when compared with check. (Contribution of Ralson Purina Company and Monsanto Chemical Company, St. Louis, Missouri).

Pre-emergence weed control in soybeans. Hansen, J. R. and J. F. Freeman. Various herbicides were applied to soybeans on upland and lowland soils in replicated randomized complete block experiments. On upland soil, Wabash soybeans were planted on May 12 in dry soil and treated May 13. Herbicides included check ester of 2,4-D, alkanolamine salt of 2,4-D, check low volatile ester of 2,4-D, and acetanalide of 2,4-D each at 1 and 2 pounds per acre; CMU at 1, 2, and 4 pounds; and chloro IPC, alkanolamine salt of DNOSBP, and Endothal, disodium salt, each at 2, 4, and 8 pounds. Principal weeds were crabgrass and green foxtail. Stands and grain yields were reduced by all 2,4-D materials at both rates, CMU at all rates, and other materials at the 8-pound rate. Chloro IPC at 4 and 8 pounds gave complete control of grasses throughout the growing season, and the 4-pound rate gave a 40 percent increase in yield over the uncultivated check. DNOSBP at 4 pounds and chloro IPC at 2 pounds gave smaller increases. On river bottoms, check low volatile ester of 2,4-D and check amine salt of MCP at 0.75, 1.0, and 1.5 pounds; alkanolamine salt of DNOSBP at 2, 4, and 8 pounds; and CMU at 1, 2, and 4 pounds were applied on May 18 to beans planted May 17. CMU at 2 and 4 pounds seriously reduced stands. Other materials had little effect on soybeans. MCP and 2,4-D reduced giant ragweed by about 60 percent at the 1.5 pound rate. DNOSBP had little effect on giant ragweed in this or in other pre-emergence tests on bottomlands. (Kentucky Agricultural Experiment Station).

Weed control in soybeans. Watson, A. J. Four field experiments were conducted in 1951 for weed control in Hawkeye soybeans. One was on infertile sandy soil while the other three were on a fertile loam. Residual pre-emergence treatments of the following materials with their acre rates were applied: DNOSBP amine salt at 4, 6, 8, 10 and 12 lb.; PCP sodium salt at 8, 12, 16, 20, 24, and 28 lb.; Sodium 2,4-dichlorophenoxy ethyl sulfate at 1, 2, 4, and 6 lb.; 2,4-D amine salt at 1 and 2 lb.; 2,4-D ester at 1 and 2 lb.; MCP amine salt at 1 and 2 lb.; MCP ester at 1 and 2 lb. and CMU at 1 and 2 lb. Results may be summarized as follows: 1) On the sandy soil of low fertility, none of the treatments gave satisfactory weed control without causing serious injury to soybeans. 2) On the finer textured soil, DNOSBP amine salt resulted in most consistent control of both annual broadleaved weeds (lamb's-quarters, common ragweed, and rape) and annual grass (Setaria spp.) at rates which were tolerated by the beans. The 6 lb. rate resulted in excellent control of broadleaved weeds while 8 to 10 lb. was required for effective controlof annual grasses. Rates of 10 or 12 lb. resulted in significant injury to beans. No permanent bean injury was observed where 8 lb. rate was applied. 3) PCP at rates up to 28 lb./A. caused no bean injury yet failed to control annual grasses. 4) All growth regulating materials caused serious injury to beans at rates sufficient to control weeds. 5) CMU proved to be a very effective herbicide but was not selective for soybeans. (The Dow Chemical Co., South Haven, Michigan).

Defoliants

Pentachlorophenol as a pre-harvest spray for soybeans. Slife, F. W. and J. L. Cartter. Two varieties of weed-free soybeans were treated with 2 1/2 gallons of 8 percent pentachlorophenol at 3-day intervals. These treatments began at an early green-bean stage and continued until all of the leaves were gone. The variety Hawkeye was treated seven times at 3-day intervals and the variety Blackhawk was treated five times at 3-day intervals. A randomized block design, with four replications, was used with each variety. Spraying was done with a tractor-mounted sprayer equipped with fenders to avoid damage to the soybeans. Leaves, stems, pods, and beans on each plot were sampled for moisture content every 3 days after treatment until the beans had dropped enough in moisture to be safe for storage. These plots are being analyzed for any residual pentachlorophenol that may be carried into the soybean oil. Mr. J. L. Cartter and his associates of the U. S. Regional Soybean Laboratory, located at Urbana, are doing a complete chemical analysis of these plots particularly to see what effect time of application has on the quantity and quality of soybean oil. Although complete data are not available yet, applications at the early green-bean stage may have reduced the yield as much as 25 percent. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois).

Pre-harvest weed control in soybeans. Slife, F. W. and J. L. Cartter. Several chemicals available for cotton defoliation were applied to weedy soybeans. These chemicals were applied by a tractor-mounted sprayer equipped to travel through soybean fields without injury to the beans. Chemicals used were: sodium monochloroacetate, sodium chlorate-borate mixture, sodium cyanamid, sodium pentachlorophenol, 8 percent pentachlorophenol in oil, 40 percent pentachlorophenol in various amounts of diesel fuel, and Dow General in various amounts of diesel fuel. The soybeans in this field were nearly mature, but could not be combined due to the green weeds. Chemicals were mixed or emulsified with water and applied at the rate of 40 gallons per acre at 100 pounds pressure. Sodium cyanamid, 8 percent pentachlorophenol in oil, 40 percent pentachlorophenol in oil, and Dow General in oil gave excellent weed control; however, the chemicals applied with oil gave slightly better control of the grass weeds. This test indicated the importance of coverage if pre-harvest weed control sprays are to be used in weedy fields. Plane application of pentachlorophenol has been very successful on fields that have not been too weedy. The Chemistry Department of the University of Illinois is analyzing the soybean oil from plots treated with oil base chemicals to determine if the petroleum oils are contaminating the soybean oil. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois).

Dow General as a pre-harvest spray in weedy soybean fields. Slife, F.W., A. J. Watson and J. L. Cartter. Dow General was applied as a pre-harvest spray to nearly mature Hawkeye soybeans for weed control. Rates used were 2 quarts of Dow General in 40 gallons of water per acre and 3 pints of Dow General in 7, 10, 14, and 15 gallons of diesel fuel emulsified in water to make 40 gallons of spray per acre. Chemicals were applied with a tractor-mounted sprayer delivering 100 pounds pressure. Dow General without oil gave poor results, but 3 pints of Dow General with 7, 10, 14, and 15 gallons of diesel fuel gave excellent control of both grass and broadleaved weeds. There seemed to be no difference between 7, 10, 14, and 15 gallon oil carrier plots. Weed species dried up by the dinitro-oil sprays were: crabgrass (Digitaria sp.), giant foxtail (Setaria faberii), barnyard grass (Echinochloa crus-galli), smartweed (Polygonum sp.),

pigweed (Amaranthus retroflexus), and velvetweed (Abutilon theophrasti). This test indicates that within limits, coverage is more important than amount of chemical per acre. More tests are needed to determine if the amount of dinitro and oil can be lowered in order to make a more economical spray. (Contribution of the Illinois Agricultural Experiment Station, Urbana, Illinois).

Pre-harvest spraying of red clover seed fields. Watson, A. J. Three experiments were conducted in red clover seed fields near Paw Paw, Michigan in September and October, 1951 to kill top growth of weeds and clover to aid direct combining. DNOSBP (phenol) in Dow General at 0.6, 1.2 and 1.8 lb. (1, 2, and 3 pt.) in 2, 5, 10, and 20 gal. of fuel oil/A. was emulsified in water and sprayed at volumes ranging from 22 to 86 gal./A. PCP (phenol) in oil was used at 4 and 6 lb. in 5, 10, and 20 gal. of fuel oil emulsified in water and applied at volumes ranging from 22 to 86 gal./A. Sodium monochloroacetate at 6, 8, 9, and 12 lb. acid equivalent/A. was used in a water spray applied with and without wetting agent at 43 gal./A. Weeds were predominately common ragweed, lambs'-quarters, Bidens spp., smartweed, and annual grasses. DNOSBP or PCP both burned the vegetation satisfactorily where an adequate rate was applied. DNOSBP at 1.2 lb. or PCP at 6 lb. in 5 gal. of fuel oil applied in a water emulsion at 25 to 50 gal./A. resulted in rapid burning of green vegetation with subsequent rapid drying. Eight days after treating, vegetation in treated areas contained 10 to 20% less moisture than the checks and direct combining was possible. Clover showed new growth 5 to 7 days after spraying. There was no advantage to using more than 5 gal. of oil per acre. Spray volumes of 22 gal./A. were only slightly less effective than 40 gal. and there was no benefit from higher volumes. Activity of sodium monochloroacetate was increased considerably by the addition of a wetting agent, however, it still was far less active than DN or PCP and was considered unsatisfactory for this purpose. (The Dow Chemical Company, South Haven, Michigan).

PROJECT III. CONTROL OF WEEDS IN FIELD CROPS

Pasture and Range Grasses. Summary by: Dayton L. Klingman

Summary

Undoubtedly, research work was done on weedy species in pastures and ranges which was either not reported or reports were sent to some other section of this Research Report. Considerably more data are needed on control and the effects of control on production and quality of forage.

In Minnesota mowing and chemicals for weed control in grass-legume mixtures in oat stubble were used. Mixtures were spring-seeded with oats. Mowing injured sweet clover stands, but did not affect stands of other legume-grass mixtures. Mowing did not control Setaria spp. satisfactorily. Sweet clover was severely injured by 2,4-D and MCP but not by 4.4 pounds TCA or by DNOSBP. Red clover and alsike were eliminated by TCA but were unaffected by the other chemicals except that the red clover stands were reduced by 2,4-D in 1951. Stands of alfalfa, timothy, or bromegrass were unaffected by any herbicide.

Pasture sage (A. frigida) in Canada treated with TCA at rates up to 100 pounds per acre August 2, 1950, gave no control of the pasture sage, but completely eliminated the grass. 2,4-D amine or ester were equally effective in reducing the pasture sage, 1/2 pound of either giving 80 per cent reduction, while 1 and 2 pounds gave 95 to 100 per cent reduction. 2,4,5-T gave but 70 per cent control at 2 pounds per acre. Growth vigor of the grasses was markedly greater in plots treated with 2,4-D or 2,4,5-T than in the checks.

Under high rainfall conditions in Iowa, quack grass, Kentucky bluegrass, and other herbaceous weeds were selectively removed from big bluestem, Indian grass, and switch grass with no apparent injury to the latter group. Chemicals used were CMU, TCA, and sodium chlorate.

Abstracts of Results of Cooperators

Control of annual weeds in first year seedings by mowing and herbicides after oat harvest. Dunham, R. S. and R. G. Robinson. This study included control methods for weeds in a 5 inch oat stubble in which there were legume and grass seedlings. Plots of alfalfa-brome, red clover-timothy, alsike clover-timothy, and sweet clover were sown with oats in 1950. Mowing 3 times after oat harvest was compared with no mowing. Also, the following herbicides were compared on mowed and unmowed areas: 2,4-D, amine at 4 oz. per acre, MCP, amine at 4 oz., TCA at 4.4 and 8.8 lbs., 2,4-D at 4 oz. plus TCA at 4.4 lbs., and DNOSBP ammonium salt at 3/8 lb. plus 3 gals. of No. 2 range oil. Rates of 2,4-D, MCP, and TCA are on the basis of acid equivalents and were applied in 20 gallons of water.

Mowing was unsatisfactory for the control of Setaria spp. The stand of sweet clover in 1951 on the mowed plots was greatly reduced. Stands of alfalfa-brome, red clover-timothy and alsike-timothy were practically unaffected by mowing.

Sweet clover was severely injured by all herbicides except TCA at 4.4 lbs. and DNOSBP. Red clover and Alsike clover were eliminated by TCA. The red clover stand

in 1951 was reduced by 2,4-D, and stands of both red clover and alsike clover were unaffected by the other herbicides. Stands of alfalfa, timothy, and brome grass were unaffected by any herbicide. The effect of herbicides on the 1951 stands of legumes was not influenced by mowing. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2757, Misc. Jour. Series, Minn. Agr. Exp. Station.)

Effect of herbicides on pasture sage (Artemisia frigida). Friesen, H. A. and Harris, M. D. An infestation of pasture sage growing in an over-grazed pasture was treated with various herbicides on August 2, 1950. The isopropyl ester and the alkanolamine amine of 2,4-D and an ester of 2,4,5-T were applied with a knapsack sprayer at dosages of 1/4, 1/2, 1 and 2 pounds of acid equivalent per acre. Sodium TCA also was applied at dosages of 20, 40, 60, 80 and 100 pounds of acid equivalent per acre. Results: In 1950 each dosage of TCA killed the native grasses and turned the sage a very deep pink color within one week after treatment. There was no further growth of grass or sage before freeze-up. In the late fall of 1951, the sage had recovered completely but the grasses showed no signs of life throughout the remainder of the season. The ester of 2,4-D at dosages of 1/2, 1 and 2 pounds and the amine of 2,4-D at 1 and 2 pounds per acre discolored the sage and caused many of the leaves to wither and drop prior to freeze-up in 1950. By late June of 1951, each of these treatments had reduced the stand of sage by 95 to 100 per cent. Furthermore, the grasses, freed of the sage competition, were taller and more vigorous than the grasses on the untreated checks. The ester at 1/2 pound and the amine at 1/2 and 1/4 pound of acid per acre resulted in reductions in the stand of sage of 80, 80 and 60 per cent, respectively. 2,4,5-T was found to be considerably less effective than 2,4-D. This was evidenced by the observation that in 1951, 2,4,5-T at 2 pounds per acre had reduced the stand of sage by only 70 per cent. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Resistance of tall prairie grasses to chemicals. Young, D. W. and W. E. Loomis. In experiments designed to clear railroad rights-of-way of vegetation, quack grass, kentucky bluegrass and miscellaneous herbaceous weeds were removed by chemical treatments from mixed stands of big bluestem, Indian grass and switch grass with no apparent injury to the tall prairie grasses. These grasses were resistant to 20 pounds of CMU per acre, to a mixture of 10 pounds of CMU with either 30 pounds of TCA, sodium salt or 80 pounds of sodium chlorate, and to a mixture of 40 pounds of TCA, sodium salt and 80 pounds of sodium chlorate per acre. All of the above treatments gave effective quack grass control. These results were obtained under high rainfall conditions of 25 inches of rain between May and October. Applications in May and July responded similarly. (Contributed by the Botany and Plant Pathology Department, Iowa Agric. Exp. Sta., Ames, Iowa.)

PROJECT III. CONTROL OF WEEDS IN FIELD CROPS.

Flax

P. J. Olson.

Summary

Twenty one abstracts are covered in this summary. They deal with all of the common formulations of 2,4-D; with TCA, MCP, IPC, Endothal, CMU, Dinitros and a few others. They involve both broad leaf and grassy weeds, the latter including wild oats and foxtail in particular. The reaction of the crop as well as weeds within the crop are dealt with and residual as well as immediate effects of the chemicals are reported. Both pre-emergence and post-emergence are involved. Some attention has been given to the effect of weed control on yield of flax.

MacDonald and others compared each of dry isopropyl amine and isopropyl amine citrate of 2,4-D with an alkanolamine of 2,4-D for control of common mustard and for the effect on the crop. They were applied at 4 oz. acid equivalent and both were found to be equal to the alkanolamine. The isopropyl amine citrate was "somewhat sharper" in its action on flax than the other two amines.

Dunham and others compared a triethanolamine salt, a butyl ester and a dimethylamine salt of 2,4-D with an amine salt of MCP. The applications were made at varying stages of growth of the flax (from 3 to 20 inches tall). In general MCP was found to be somewhat more effective in the control of mustard than the 2,4-D products, and did somewhat less damage to the flax crop than these.

Foster compared a butyl ester, a sodium salt and an amine formulation of MCP with an ethyl ester of 2,4-D. The control of mustard was found to be essentially equal to the MCP and 2,4-D at corresponding rates. The MCP damaged flax less, and delayed maturity less.

Several workers reported upon application of TCA for control of grassy weeds in flax. Dunham et al, MacDonald et al, Kratochvil and Helgeson obtained excellent control of Setaria at rates of 5 to 15 pounds per acre without damaging the flax.

IPC was applied by Kratochvil and Helgeson, who got no control of Setaria and by MacDonald et al, who got no control of wild oats. In both cases flax was injured.

Endothal was used by Kratochvil and Helgeson and by Le Tourneau et al. In both cases control of Setaria was obtained, but flax was also damaged. Flax was destroyed when rates of 4 and 8 lbs. per acre were applied in the pre-bud stage. Le Tourneau et al found that Brassica alba, Brassica arvensis and Polygonum sp. were also eliminated at these rates. Chenopodium album was resistant at all rates.

Le Tourneau et al made pre-emergence application of a number of chemicals. Disodium endothal, "Pre- merge", dimethylene salt of 2,4-D, and two other chemicals (see abstract). Endothal damaged flax severely and reduced the stand of Setaria up to 50%. B. arvensis, C. album and Polygonum sp. were not affected. The amine salt of 2,4-D had no effect upon Setaria or Polygonum but controlled B. arvensis B. alba and C. album. "Pre-merge", at rates of 3, 6 and 9 lbs. per acre eliminated all vegetation. One of the "other chemicals" (FLN-646A) was found to be most promising of all the herbicides tried.

Foster made pre-emergence application of TCA for control of wild oats in flax. Rates from 10 to 100 lbs. per acre were used. The 40 lb. rate was found most effective having reduced the stand of wild oats from 112 to 10 per plot and the stand of flax by only 10 per cent. The residual effect as measured by reduction in yield of wheat the following year was very pronounced.

Robinson and Dunham, studying the residual effect of TCA on yield of flax found reduction in yield only where rates as high as 88 lbs. per acre had been used. Lower rates applied ranged from 11 to 66 lbs. per acre. This work was done at University Farm, St. Paul, Minnesota. Foster's work was done at Regina, Sask.

The results of 3 experiments dealing exclusively with the reaction of flax (not weeds in flax) to various weedicides were reporte Friesen and Olson reported results of three years' work involving the reaction of the crop to treatments with butyl and isopropyl ester of 2,4-D at 20 or more stages of growth. The treatments were applied at 3 day intervals beginning before emergence and continuing into boll stages. These results show that damage, reflected in significant to sharply reduced yields, sets in the early bud stage, and continues until the plants are 10 to 14 days past full bloom. Treatments prior to the early bud stage cause no significant damage. In 1949 and 1950, 2 or 3 treatments during or just before full bloom, did not reduce yields significantly.

At Saskatoon, Sask. Coupland applied TCA, IPC, and MH as pre-emergence treatment, and when the flax was in the 4-5 leaf stage. The pre-emergence treatment of IPC and MH caused severe damage at the 40 and 80 pound rates. At post-emergence severe damage resulted from 40 and 80 lbs. IPC and MH and also from 20 lbs. of MH. TCA caused severe damage at 80 lbs. No damage was caused by any of the chemicals at 2.5, 5 and 10 lbs.

At Beaverlodge, Alberta, Carder found that CMU caused some damage at rates as low as 1 pound per acre. At 2 and 3 lbs. flax was very severely damaged or destroyed.

The effect of chemical weed control on yield of flax was reported upon by Olson and Burrows. They found an average increase of 12 bu. per acre from controlling common mustard (B. arvensis), Stinkweed (Thlaspi arvense) and Cranesbill (Geranium maculatum) where the total concentration of these was 81 plants per sq. yard with common mustard constituting 52 per cent, stinkweed, 18 per cent and Cranesbill 18 per cent. Control by means of Butyl ester spray at 4 oz. acid equivalent per acre and by pulling the weeds gave

essentially the same results, the weed free plots yielding about 18 bushels per acre.

The effect of methods and rates of sowing on yield of flax, and of weeds in flax was studied by Robinson and Dunham. Basic amounts of 28, 56, 84 and 112 pounds per acre were used for sowing in one direction, and different combinations of these rates were achieved by cross sowing. Two spacings were used, namely 3 and 6 inches. The minimum rate was 28 lbs. per acre and the maximum 168 (56 in one direction, 112 in the other). The lowest yield of flax and highest yield of weeds was obtained at the 28 lb. rate. Higher rates than 56 lbs. sown in one direction did not increase yields of flax or reduce weeds. Cross sowings generally returned higher yields of flax and lower yields of weeds than one direction sowing.. Spacing at 3 inches showed no advantage over 6 inches.

Only one report was received covering differential response of varieties. Coupland: A 2,4-D amine was applied at 4 and 8 oz. per acre at two stages, namely 6 to 12 inches (June 30) and 15 to 20 inches (in bloom, July 23). The order of yield decrease due to treatment was Redwing, Victory, Royal, Rocket, Dakota Arrow. (Redwing decreased least, Arrow decreased most). The ascending order of delay in maturity due to treatment was Victory, Royal, Redwing, Dakota Arrow, Rocket. (Victory delayed least, Rocket most.) Maximum delay under the first stage treatment was 15 days. Some varieties were not delayed under this treatment. At the second stage all varieties were delayed, the range being from 22 to 31 days. (Since these varieties differ in earliness, some of them by a considerable margin, the stage of growth was not the same for all varieties at each of the spraying dates.)

One report covered pre-harvest spraying for destruction of weeds in a mature crop. Derscheid applied dinitro by airplane using rates of 2 and 3 pints per acre with No. 1 fuel oil as the diluent. The spraying was done August 22, when the crop was almost mature. All top growth except wild buckwheat was killed, and all treatments were equally effective. The author sees much promise in the procedure for facilitating combining and reducing incidence of "scab".

Fiber flax was involved in reports from one station. Mackey and Chubb of Portage la Prairie applied a sodium salt of MCP and of TCA to the variety Liral Dominion. MCP had no effect on straw length, yield of straw, yield of seed oil content or iodine number of seed. TCA at rates of 5, 10 and 20 lbs. reduced the length of straw and stand of flax. The growth of Setaria was well controlled by all of the treatments: destroyed or practically destroyed by the 10 and 20 lb. treatments.

ABSTRACT OF RESULTS OF CO-OPERATORS

Response of field crops to CMU. Carder, A. C. Six rows each of Saunders wheat, Victory oats, Olli barley, Chancellor peas, Redwing flax and Arctic sweet clover were sown 7 inches apart, and 24 feet long. Superimposed across the rows immediately after seeding were 6 rates of CMU: nil, 1/4, 1/2, 1, 2 and 3 pounds active ingredient per acre. Emergence and early growth of the various crops were slow due to unseasonable cold and dry, windy conditions until early July when warm, torrential rains occurred which continued through July and early August. The initial storm caused overwash and deposition of seeds of annual weeds in such fashion that following germination weed control by the chemical was difficult to gauge. Recurrent rains delayed ripening unduly so that harvest data were not secured. Examination 3 months after treatment indicated that 1/2 pound of CMU per Acre suppressed the growth of sweet clover, while at 2 pounds and over the legume was entirely eliminated. The flax and barley were the next most sensitive indicating some reduction of vigour with the 1-pound rate, while the peas, oats and wheat showed no effects at this dosage. At the 2-pound rate only the oats and wheat showed any marked tolerance towards the chemical. Complete killing or severe injury occurred with all crops at the 3-pound application. Here also, oats and wheat were least affected. Annual weeds such as shepherd's purse and flixweed appeared largely controlled by the 1/2-pound-per-acre dosage. (Contribution of Dominion Experimental Station, Beaverlodge, Alberta).

Response of cereals and flax to TCA, IPC and MH. Coupland, R. T. TCA, IPC and MH were applied to cereals (oats, wheat, barley) and flax at Saskatoon at the following rates: 0, 2.5, 5, 10, 20, 40 and 80 lb. of acid per acre in 75 gallons of water. Treatment was made on June 29 to crops in two stages. Stage 1(sown June 4), wheat - 5 to 6 in., barley - 9 to 10 in., oats - 7 to 8 in. and flax - 4 to 5 leaves; stage 2 (sown June 26), pre-emergence. In the pre-emergence treatment 80 lb. of TCA and 40 and 80 lb. of IPC caused slight damage to cereals, while flax suffered slightly from 80 lb. of TCA and severely from 40 and 80 lb. of IPC and MH. Post-emergence treatments causing severe damage to cereals and flax were 20, 40 and 80 lb. of MH, 80 lb. of TCA, and 40 and 80 lb. of IPC. Considerable damage resulted from 20 lb. of IPC and 40 lb. of TCA. All other treatments resulted in no observable damage. (Contribution from the Department of Plant Ecology, University of Saskatchewan, Saskatoon.

Differential response of six varieties of flax to 2,4-D, 1951. Courland, R. T. 2,4-D amine, (a mixture - Naugatuck) and ester (butyl) at 0, 4 and 8 oz. per acre were applied to quadruplicated, weed-free plots in a randomized block design in two stages of development. Stage 1, June 30, when the flax was 6 to 12 in. high; stage 2, July 23, when flax was 15 to 20 in. high and in flower. The order of varieties from most resistant to susceptible on the basis of yield decrease caused by treatment was Redwing, Victory, Royal, Rocket, Dakota and Arrow.

Delay in maturity was caused by treatment, in order of increasing delay, as follows: Victory, Royal, Redwing, Dakota, Arrow and Rocket. The range in the first stage was from an average of 0 to 15 days delay in maturity from various treatments and in the second from 22 to 31 days. (Contribution of the Department of Plant Ecology, University of Saskatchewan, Saskatoon, Sask.)

Pre-harvest spraying of flax with dinitro. Derscheid, Lyle A. Duplicate 4/5 acre plots of Marine flax were sprayed by airplane. DNOSBP-phenol in oil was applied at the rates of 2 pts. and 3 pts. per acre in each of three volumes--2 gal., 6 gal. and 10 gal.--of solution per acre. No. 1 fuel oil was used as the diluent. The spraying was done on August 22, 1951 when flax was almost ripe, when wind velocity was 5 mph at right angles to direction of spraying. It took one week to kill the top growth of weeds. All top growth, except wild buckwheat was killed. All six treatments were equally effective. If this chemical were applied a day or two before flax seed was ripe, it appears that the vegetative growth would be killed and straight combining would be facilitated. Also in a year of high humidity, such as 1951, the incidence of a disease that is incorrectly, but commonly called scab could be decreased. This disease attacks the flax seed after the seed is ripe and increases in severity until harvest. If the vegetative growth were killed, the harvesting could be done sooner and severity of the disease reduced. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station).

A comparison of 2,4-D, and MCP when sprayed on flax and wild mustard. Dunham, R. S., O. H. Shulstad, A. F. Wiese, and R. G. Robinson. Comparisons of the effects of 2,4-D and MCP on flax kept weed-free by hand cultivation and on wild mustard sown in flax were made from 1949-1951. In 1949 a triethanolamine salt of 2,4-D at 0,2, 3, 4, and 8 oz. of acid equivalent per acre, and a 10% sodium salt of MCP (Phenosylene) at 0, 4, 6, 8, and 16 oz. of acid equivalent per acre were sprayed on Koto and Crystal flax when 5 - 6 inches tall using 22 gals of spray per acre. Yields of both varieties were reduced significantly by 4 oz. of 2,4-D amine and 1 oz. of the ester. Yields of Koto were reduced significantly by 8 and 16 oz. of MCP and yields of Crystal by 4, 6, 8 and 16 oz. Straw yields of Koto were reduced significantly by 8 oz. of 2,4-D and 16 oz. of MCP. Straw yields of Crystal were reduced significantly by 1, 1.5, and 2 oz. of ester, 2, 3, 4 and 8 oz. of 2,4-D amine and 6, 8, and 16 oz. of MCP. In an identical trial, except that wild mustard was sown with the flax, all rates of MCP but only 8 oz. of 2,4-D resulted in 100% kill of the weed.

In 1950, a dimethylamine salt of 2,4-D at4 oz. per acre and an amine salt of MCP (Dow A548) at 0, 2, 3, 4, and 6 oz. per acre were sprayed on Redwood and Minerva when 4 - 6 inches tall. There were no significant differences in yields of seed or straw. In an identical trial except that wild mustard was sown with the flax, more mustard was killed by 3 oz. of MCP than 4 oz. of 2,4-D.

In 1951, a triethanolamine salt of 2,4-D at 4 oz. of acid equivalent per acre and an amine salt of MCP at 4 oz. were sprayed on Sheyenne, Redwood, and B5128 when 3 inches, 4 - 6 inches, and 13 - 20 inches (pre-bud) tall. In 44 out of 54 comparisons, yields of seed and

straw from untreated plots were less than from untreated plots. In 20 out of 27 comparisons, yields of seed and straw were reduced less by MCP than 2,4-D. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2750, Sci. Jour. Series, Minn. Agr. Exp. Station).

Control of annual weeds in flax by post-emergence applications of TCA alone and with 2,4-D. Dunham, R. S., O. H. Shulstad, A. F. Wiese, and R. G. Robinson. B5128 was sprayed when the flax was 3 inches and Setaria spp. were in the 2-leaf stage and smaller. Treatments were TCA at 4.4 lbs. and 8.8 lbs. in 15 gals. of water per acre, TCA at 4.4 lbs. and 8.8 lbs. in 40 gals. of water per acre, and TCA at 4.4 lbs. and 8.8 lbs. in combination with 3 oz. of 2,4-D amine salt. All rates refer to acid equivalents. Treatments were made to square rod plots and replicated 3 times.

None of the treatments reduced yields of flax seed or straw. All treatments reduced yields of broadleaf and grass weeds significantly. Grass weeds were controlled best by 10 lbs. of TCA; best total weed control resulted from 10 lbs. of TCA and 3 oz. of 2,4-D. The 40 gallon volume tended to give better grass weed control than 15 gallons. Differences in the control of grass weeds due to rates and volumes were slight. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2754, Sci. Jour. Series, Minn. Agr. Exp. Station).

Residual effect of TCA when applied to flax for wild oat control. Foster, J. Roe. In 1950 trichloroacetic acid was applied as a pre-emergence treatment to flax on an area infested with wild oats. Duplicate sets of plots were treated at rates of 10, 20, 40, 60 and 100 pounds per acre. Good control of wild oats was obtained with 40 pounds or more per acre, but the 60 and 100 pound rates give no greater control than the 40 pound rate. In 1951 these plots were sown to wheat and the residual effect of the TCA was observed. Wheat plots which had been treated with 10, 20, 40, 60 and 100 pound rates the previous year had stands of 95%, 82.5% 8%, 4% and 13.5% respectively. In addition, the wheat where 40 pounds or more had been applied was only half as tall as the untreated checks. There were fewer wild oats following the heavier treatments, but these were all large healthy plants. (Contribution from the Dominion Experimental Sub-Station, Regina, Saskatchewan, Canada.)

Effect of MCP on weeds and flax. Foster, J. Roe and Molberg, E.S. Butyl ester, sodium salt, and amine formulations of MCP (2-Methyl-4-chlorophenoxyacetic acid) were applied to Royal flax in 1951. An ethyl ester of 2,4-D was included for comparison. Rates of 2, 4, 8 and 16 ounces of acid equivalent per acre was applied to quadruplicated plots 1/2 square rod in size. The applications were made 3 weeks after emergence of the crops. At this time the weeds, principally wild mustard (Sinapes arvensis) were in the rosette stage. All MCP treatments controlled the weeds as well as the 2,4-D at comparable rates except the 2 ounce rate of the amine MCP, which gave 86.2% weed kill compared with 91.7% for the 2,4-D. The MCP caused less delay in maturity and a much smaller reduction in stand of flax, particularly with the 8 and 16 ounce applications. Yield data are not yet available. (Contribution of the Dominion Experiment Sub-Station, Regina, Saskatchewan, Canada.)

Response of foxtail (Setaria viridis and lutescens) infested flax to several herbicides. Kratochvil, D. E. and Helgeson, E. A. Square rod plots of foxtail infested flax were treated at the cotyledonary to 2 true leaf stage with 5, 10 or 15 pounds per acre of Sodium TCA, 4 or 8 pounds of Chloro-IPC, or 4 or 8 pounds of Endothal. The Setaria had 4 to 6 true leaves and were starting to tiller. Stand counts and estimation of vigor of the flax and weeds were made at harvest time. No injury to flax was observed at any rate of TCA, while virtually all Setaria was eliminated from the plots. Chloro-IPC injured the flax at both rates and did not give any appreciable control of Setaria. Endothal at 4 pounds reduced the flax to 30% of the check, at 8 pounds flax was eliminated. Setaria was satisfactorily controlled by Endothal at the two rates. (Contributed by Weed Investigations, EPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station).

Disodium 3,6-endoxyhexahydrophthalate as a post-emergence herbicide in flax. 1/ Le Tourneau, Duane and H. G. Heggeness. Quadruplicate plots of Minerva flax were sprayed with ME-3001 (disodium 3,6-E plus ammonium sulfate) and ME-3003 (aqueous solution of disodium 3,6-E). Rates of 1, 2, 4, and 8 lbs. per acre were used in the pre-bud study while 1/4, 1/2, 3/4, 1 and 2 lbs. per acre were used in the bud stage study. Applications were made in water at the rate of 100 gallons per acre. In the pre-bud study 4 and 8 lbs. eliminated flax. Brassica alba, B. arvensis, Polygonum species, and Setaria species. These rates caused foliar burning on Cirsium arvense. Lower rates reduced the flax stand excessively without controlling B. alba and B. arvensis adequately but there was 80-90% reduction in the Setaria population. Chenopodium album was resistant to both formulations at all rates.

All rates of both formulations reduced the flax stand in the bud stage spraying Polygonum species were controlled by all rates and the Setaria population was reduced 40-50% by 1 and 2 lbs. It appeared that the Setaria became more resistant to injury as it matured. Foliage and stems of C. arvense were badly damaged and all the top growth was usually killed by 1 and 2 lbs. New growth emerged immediately around the dead plants. Chenopodium album was not affected by either formulation. ME-3001 was more effective than ME-3003 in both trials. Although certain species of weeds were controlled by disodium 3,6-E it was concluded that it is not sufficiently selective to be used for flax in the pre-bud and bud stage of development. (Contribution of the Division of Plant Pathology and Agricultural Botany, Minnesota Agricultural Experiment Station.)

1/ Paper No. 2743, Scientific Journal Series Article, Minnesota Agricultural Experiment Station.

Evaluation of herbicides for pre-emergence use in flax. 1/ Le Tourneau, Duane and H. G. Heggeness. Quadruplicate plots of Minerva flax were sprayed 2 to 3 days before emergence with disodium 3,6-endoxyhexahydrophthalate as ME-3001 and ME-3003 at 1, 2, 4, and 8 lbs. per acre; "Pre-merge" at 3, 6, and 9 lbs. per acre; dimethylamine salt of 2,4-D at 1, 2 and 4 lbs. per acre of 2,4-D; LFN-646A at 1,2, and 4 lbs. per acre; and Herbicide 5722 at 1, 2, 4, and 8 lbs per acre. LFN-646A was applied in fuel oil at 100 gallons per acre, other materials were applied in water at 100 gallons per acre. Four

and 8 lbs. of ME-3001 and ME-3003 reduced the flax stand 50% and the Setaria species stand 30-50%. Eight lbs. caused a burning of flax and Setaria at the ground level and resulted in sparse root systems. ME-3001 was more effective than ME-3003. The population of Brassica arvensis, B. alba, Chenopodium album, and Polygonum species was not affected by ME-3001 or ME-3003. The dimethylamine salt of 2,4-D had no effect on Setaria or Polygonum species, but controlled B. arvensis, B. alba and C. album. Two lb. rates were superior. Rates of "Pre-merge" used were too great and in most cases vegetation was eliminated. Herbicide 5722 at 4 and 8 lbs. reduced the Setaria population 50%. Eight lbs. caused a rolling and curling of Setaria leaves and a stunting of the plants. Other vegetation was not affected by Herbicide 5722. LFN-646A controlled B.alba, B. arvensis,and C.album. One lb. rates were superior because the flax stand was not affected. Of the herbicides used, LFN-646A appeared most promising. (Contribution of the Division of Plant Pathology and Agricultural Botany, Minnesota Agricultural Experiment Station.)

1/ Paper No. 2745, Scientific Journal Series Article, Minnesota Agricultural Experiment Station.

Reaction of flax to 2,4-D applied at different stages of growth. Friesen, George and Olson, P. J. Butyl ester of 2,4-D was applied to Dakota flax at 20 stages of growth beginning 4 days before emergence and continuing at approximately 3 day intervals until the plants were past the full bloom stage. The rate of application was 8 ounces acid equivalent per acre. The results showed the most susceptible period to be from the very early bud stage to about 10 days past full bloom. All applications made during this period resulted in a highly significant reduction in yield. This period extended from the 13th date (June 27) to the 20th date (July 19). These results agree closely with those obtained in 1949 and 1950. In 1949 significant reductions in yield occurred from the very early bud stage to 14 days past full bloom with the exception of 2 dates (7 and 4 days before full bloom). In 1950 yields were significantly reduced from the very early bloom stage to 10 days past full bloom with the exception of 3 spraying dates made at the full bloom stage. In 1951, one other stage (6th date, plants 2" tall) reduced the yield to a point just below the 5% level of significance. At the 5% level such a variation could be expected to occur once in 20 trials by chance alone. Furthermore, the reality of this reduction is doubtful as no significant damage was done prior to the early bud stage in 1949 and 1950. It would therefore seem that this reduction can be attributed to chance variation in random sampling. (Contribution from the Division of Plant Science, University of Manitoba, Winnipeg, Canada.)

Application of 2,4-D amine for control of annual broad-leaf weeds in flax at 3 locations, one each in N. Dak., S. Dak., and Minnesota. MacDonald, W. P.; Zinter, C.C.; Slough, A. T. In early June 75% isopropyl amine (dry) was applied at 4 oz. acid equiv. per acre. 75% 2,4-Dichlorophenoxyisopropylaminecitrate (dry) was applied at 4 oz. acid equiv. per acre. Two and 4 oz. acid equiv. of an alkanolamine (liquid) was applied as a check. These products applied in water to equal 10 gal. solution per acre. Wild mustard principal weed. Flax variety B5128 sprayed when 3-5 in. high. On July 11 dry isopropyl amine was equal to equiv. rates of alkanolamine, on control

of wild mustard and effect on flax. DIAC was equal in control of mustard but sharper in reaction on flax in appearance and final yields. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis, Minnesota.)

Application of TCA for the control of annual grasses in flax in 1951 at three locations, one each in N. Dak., S. Dak., & Minn. MacDonald, W. P.; Zinter, C. C.; Slough, A. T. In early June 90% sodium TCA was applied at 5 & 10 lbs. of produce per acre; 71% calcium TCA was applied at 5 1/2 & 11 lbs. of product per acre and 5 lbs. of sodium TCA was applied with 4 ounces of an alkanolamine 2,4-D, with three replications at each rate with plots randomized. The spray solution was applied at 10 gals. of water per acre. At time of treatment flax (B5128) was 3-5 in. in height and the Setaria 2-4 in. in height. No injury to flax was observed at either rate with sodium or calcium TCA at the three locations. Control of Setaria was considered satisfactory with both calcium and sodium TCA on July 12. At harvest time control was estimated as 90% or more in every case. Where the combination of TCA and 2,4-D were used, the control of Setaria and annual broad-leaves was considered satisfactory and equal to a like quantity of either chemical. All sodium TCA plots at two locations gave some increase in yield, with an average of 0.97 bu. per acre. Results were negative at the third. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis, Minn.)

Application of Isopropyl-N-phenylcarbamate and Chloro-isopropyl-N-phenylcarbamate to flax at 3 locations, one each in N. Dak., S. Dak., and Minn. in 1951. MacDonald, W. P.; Zinter, C.C., Slough, A. T. Liquid IPC (solvents ethylene dichloride and zylol), 2 lbs. per gal. were applied at 2 1/2, 5, 7 1/2 lbs. acid equiv. per acre. 40.6% Chloro-IPC (liquid) was applied at 2 and 4 lbs. acid equiv. per acre. Both applied with water at 10 gals. per acre. Flax 3-5 inches in height and wild oats 3-5 in in height. IPC injured flax and reduced yield at both rates. No significant control of wild oats with either chemical. (Contribution of Agr. Dept., F. H. Peavey & Co., Minneapolis, Minn.)

Effect of MCP on Fibre Flax - 1950. Mackey, E. M. and W. O. Chubb. Liral Dominion Flax was treated when 3 inches tall with 0, 8, 16 and 24 oz. acid equivalent per acre of the sodium salt of MCP. Application was made in a spray of 40 gallons, U.S., per acre. Treatments were replicated 3 times. Hand-weeded, 1/160 acre plots were used. There was a rainfall about 10 hours after the MCP was applied. Rainfall was abundant both before and after the treatments. Although there was considerable immediate reaction in all cases, none of the treatments significantly affected straw length, yields of whole straw, broken straw or cleaned seed, seed oil content or seed oil iodine number. (Contribution of the Dominion Pilot Flax Mill, Experimental Farms Service, Portage la Prairie, Manitoba.)

Effect of TCA on Fibre Flax - 1951 Chubb, W. O. and E. M. Mackey. The sodium salt of TCA was applied as a spray (80 gals. U.S. total spray liquid per acre) to plots sown with Liral Dominion flax, immediately after seeding the flax. Dosage rates were 0, 5, 10 and 20 lbs. acid equivalent per acre. Treatments were replicated 3 times. Plot size was 1/160 acre. All treatments

reduced the length of straw (4 to 7 inches) and stands of the flax. Growth on the treated plots was uneven and lacking in vigor. Two months after the treatment, the stands on the 0, 5, 10 and 20 lb. plots were respectively 254, 216, 192 and 131 per yard of row (all differences significant). At the same period the counts of Setaria viridis, per sampling area, were respectively 155, 12, 2 and 0. (all differences significant). (Contribution of the Dominion Pilot Flax Mill, Experimental Farms Service, Portage la Prairie, Manitoba.)

Effect of chemical weed control on yield in flax. Olson, P. J. and Burrows, V. D. A field of weedy flax was selected as a site for this experiment. The experimental design was a split plot with 4 replicates, blocks being weedy and weed free. Each block was divided into treated and untreated plots. Butyl ester of 2,4-D was applied at 4 ounces acid equivalent per acre when the flax was 2"-3" in height. The weeds at this time were just past the seed leaf stage. Counts indicated that there was an average of 81 weeds per square yard with a remarkably uniform weed population. This population consisted of 52.4% Brassica arvensis, 18.8% Thlaspi arvense, 17.7% Geranium maculatim, 7.8% Amaranthus retroflexus, 2.4% Chenopodium album, 0.9% Circium arvense. The treated plots exhibited delayed blossoming but there was no thinning of the stand. Decided thinning caused by plant competition was observed in the untreated weedy plots. The average yields of flax in bushels per acre for the weed free treated and untreated were 18.42 and 18.38 respectively. This compares with 17.25 bushels for the weedy treated and 4.59 bus. for the weedy untreated, a difference of 12.66 bushels. The least significant difference was .9327 bus. There was no significant difference between the weed free treated and untreated or the weedy treated plots. However, all these groups differed strikingly from the weedy untreated. There was therefore a 12.66 bus. increase due to chemical control of weeds. (Contribution of Division of Plant Science, University of Manitoba, Winnipeg.)

Effect of methods and rates of sowing flax on yields of weeds, flax seed, and flax straw. Robinson, R. G. and R. S. Dunham. In 1950, Dakota flax was sown in one direction at 28 and 56 lbs. per acre and cross-sown at 28 x 28, 28 x56, and 56 x 56 lbs. per acre. In 1951, B5128 flax was sown in one direction at 28, 56, 84, and 112 lbs. per acre and cross-sown at 28 x 28, 28 x 56, 56 x 56, 28 x 84, 56 x 84, 28 x 112, and 56 x 112. All sowings were made with a grain drill with 6" spacing. In 1951, other spacing combinations were added as follows: 56 lbs. (3" space), 56(3") x 56(3"), 56(3") x 56(6"), 56(3") x 28(6"), 56(3") x 112(6"), 56(3") x 84(6") and 70 lbs. broadcasted. All treatments were replicated three times on plots approximately one square rod in area.

In both years, the 28 lb. sowing yielded less seed and straw and more weeds than 56 lbs. Sown in one direction, rates higher than 56 lbs. did not increase yields of seed or straw or reduce weeds. Broadcasting resulted in lower yields of flax and more weeds than 56 lbs. drilled. Cross-sowings at greater rates also yielded more flax seed. Cross-sowing of B5128 in 1951 showed no advantage over sowing in one direction in yields of seed or straw or in weed

control. Spacing at 3 inches showed no advantage in yields or weed control when sown either in one direction or crosswise. Spacings of 3 x 6 inches tended to yield more straw with fewer weeds than 6 x 6 or 3 x 3 inch spacings. (Contribution from the Division ofAgronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2755, Sci. Jour. Series, Minn. Agr. Exp. Station).

Control of annual weeds in flax by post-emergence applications of TCA. Soine, O. C., and R. S. Dunham. Redwood was sprayed with TCA at 4.4 lbs., 7 lbs., and 8.8 lbs. of acid equivalent per acre. Treatments were made to square rod plots and replicated 4 times. These trials were conducted at the Northwest Experiment Station, Crookston.

Significant differences in yields of seed and straw were not obtained but yields were larger on plots treated with 4.4 and 7 lbs. than on untreated. The 8.8 lb. rate reduced yields of seed 1.7 bu. and yield of straw 133 lbs. per acre. Excellent control of grass weeds was obtained from all rates although slightly more control resulted from 8.8 lbs. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No.2748, Sci. Jour. Series, Minn. Agr. Exp. Station).

The relative tolerance of field crops to residues of TCA in the soil. Robinson, R. G. and E. S. Dunham. Application ofTCA at various rates were made to an old quackgrass sod in September, 1948, 1949 and 1950. Continued cropping has followed the fall applications and yields have been taken to determine injury from the residues of TCA.

Soybeans planted in 1949 following applications of 0, 11, 22, 44, 66, 88, and 176 lbs. acid equivalent per acre in September, 1948 showed such severe injury from all rates that no yields were taken. In 1950, yields were materially reduced by the 1948 applications of 44, 88 and 176 lbs. per acre. In 1951 no injury was apparent so no yields were taken. Applications made in September, 1949 and 1950 also severely injured soybeans planted the following spring.

Corn planted in 1949 following similar applications made in September, 1948 was slightly injured by 11 lbs. and severely damaged by all higher rates, but no yields were obtained. Corn planted in 1950 following September treatments in 1949 was again severely injured at rates of 31, 44, 66, and 88 lbs. per acre. Corn planted in 1951 following September treatments in 1950 of 22 lbs. per acre showed no injury or reduction in yield. Corn planted in May, 1951, on land that had received 22 lbs. of TCA in April, 1951 was killed.

Flax sown in 1949 following applications of 0, 11, 22, 44, 66, 88, and 176 lbs. per acre in September 1948 showed leaf firing from the 88 and 176 lb. rates. Yields were not taken but there was no apparent injury from the other rates. The yield of flax sown in 1950 following applications of 31, 44, 66, and 88 lbs. per acre in September 1949 was reduced only by the 88 lb. rate. Yields of flax sown in 1951 following both September, 1950 and April, 1951 applications of 22 lbs. per acre were not reduced.

Mindo oats sown in 1949 following applications of 11 to 176 lbs. per acre in September 1948, matured without any apparent injury. Symptoms of injury on soybeans, corn, and flax appeared in June and July after the oats were fully headed. The yields of Mindo sown in 1950 following applications of 31-88 lbs. per acre in September, 1949 were not reduced.

Wheat, barley, oats, and flax were sown in 1951 following applications of 0, 22, 31, and 44 lbs. in September, 1950. Wheat was practically eliminated. Barley yields were severely reduced by 44 lbs. and injury was apparent at 31 lbs. Oats showed no injury at any rate but yields were slightly lower on treated plots. Flax showed no injury or yield reduction from any rate. Red clover was sown with flax. Stands were reduced 30% by the 22 lb. application, and about 65% by 31 and 44 lbs.

Tolerance of the crops used was in the following descending order: flax, oats, corn, barley, wheat, and soybeans. Red clover appeared less tolerant than alfalfa. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2752 Sci. Jour. Series, Minn. Agr. Exp. Station.)

Effect of Herbicides on flax varieties. Breakey, W. J. and Johnson, K. The Butyl ester and alkanolamine amine of 2,4-D at 3 and 5 ounces of acid equivalent per acre were sprayed on 3 varieties, Rocket, Redwood and Dakota. Plots were replicated three times and sprayed June 5th when plants were approximately four inches in height. Results: on the amine sprayed plots there was a slight curling at the top of plants. The effect of the ester spraying was more pronounced, plants showed more twisting and curling with much more drooping. Seven days after spraying all plots effected were erect. The weather was dry but cool, and the plants required less time for recovery in 1951 than in 1950. The interaction between varieties and treatments is significant at the 1% level, that is, one or more treatments effected one variety differently to another. The necessary difference being 2.09 bushels. Yield results showed no significant difference between variety yields in the experiment as a whole. (Contributed by the Dominion Experimental Station, Morden, Man.)

Reaction of linseed flax to various herbicides. Friesen, H. A. and Harris, M. D. Non-replicated plots of Dakota flax were sprayed with the sodium salt, amine and butyl ester of MCPA, as well as with the alkanolamine amine and butyl ester of 2,4-D. Each formulation was applied at dosages of 1/8, ¼, 3/8 and ½ pound of acid equivalent per acre, when the flax was 5 inches tall. The plots were heavily infested with young Thlaspi arvense and Solsola pestifer; Polygonum Convolvulus, Chenopodium album and Axyris amarantoides were also present. The sodium salt and amine of MCPA were unsatisfactory at all dosages tested since they resulted in essentially no weed control, however, they also had no visible effect on the flax. The butyl ester of MCPA resulted in 80 percent kills of Thlaspi. Chenopodium and Axyris at dosages of 3/8 and ½ pound per acre, but delayed flowering in the flax by 9 days. The amine and ester of 2,4-D at 1/8 pound gave 75 percent kills of all species except Polygonum, however, the ester delayed flowering by 3 days. The ¼, 3/8 and ½ pound dosages of the ester (2,4-D) delayed flowering by as much as 2 weeks, while the 3/8 and ½ pound dosages stunted the flax and reduced the number of bolls formed. The outstanding treatments were the ¼ and 3/8 pound dosages of the amine (2,4-D). 95 percent kills of all weed species except Polygonum (which was stunted but not killed) were observed. Furthermore, the flax appeared to suffer no injury from these treatments. The ½ pound dosage of the amine seriously delayed and deformed the flax. Yield data not obtained due to frost and snow. (Contributed by the Dominion Experimental Station, Scott, Sask.)

Project IV. Control of Weeds in Vegetable Crops, Potatoes, Sugar Beets, Small Fruits and Ornamentals.

Small Fruits and Ornamentals — R. E. Nylund

Summary

Data on weed control in strawberries indicate that application of 2,4D to new plantings made at the time of initiation and early growth of runner plants tend to reduce runner production. Preplanting treatments or late summer treatments evidently did not materially affect runner production. 2,4D treatments during the first year which did not reduce runner production did not result in reduced yields in the fruiting year. Application of 1 lb. of 2,4D to strawberries about two weeks before flowering caused some reduction in fruiting, but lower rates evidently did not adversely affect fruiting. A test of nine varieties of June bearing strawberries indicated that these varieties did not react differentially to two one pound applications of 2,4D ester applied in their first year in the field, and that yields were not reduced by such treatment. E.H. No. 1 (Sodium 2,4 dichlorophenylethylenedioxysulphate) has given good control of annual weeds including grasses when applied at 5 to 8 lbs. per acre before weed emergence. Rates of over 4 lbs. tend to reduce runner production of strawberries, although in one experiment rates as high as 8 lbs. per acre did not result in reduced yields. Evidently when applied at runner formation time and at rates necessary for good weed control, E.H. No.1 inhibits runner production less than 2,4D. Effective weed control without yield reductions was also obtained in four varieties of everbearing strawberries by the application of E.H. No.1 at 4 lbs. per acre one month after planting followed by a second application of 6 pounds one month after the first. E.H. No.2 (dichloral urea) at rates which give effective weed control (more than 6 pounds per acre) seriously reduced runner production of June bearing strawberries. Endothal, xanthogen disulphide, and maleic hydrazide applied as pre-planting and summer foliage sprays were toxic to strawberries when applied at rates which gave effective weed control likewise preplanting treatment with DNOSBP-amine salt at 10 pounds, PCP-sodium salt at 10 pounds, or endothal at 8 pounds reduced strawberry runner production and otherwise seriously injured plants. Post planting treatments with CIPC (isopropyl-n-(3-chlorophenyl) carbamate) at 10 and 15 pounds and CMU (p-chlorophenyl dimethylurea) at ½ and 3 pounds per acre severely injured strawberry plants. A novel method of controlling hard-to-kill weeds in strawberries is indicated by one author (Davidson) who successfully killed German knotgrass, chickweed, and sheep sorrel by a late fall application of 1.8 lbs. of DNOSBP-phenol in fuel oil and water. Although the strawberry foliage was burned to the crown, little permanent injury was observed during the following year.

Only one report on weed control in raspberries was received. Application of 4 and 6 lbs. per acre of E.H. No.1 in new plantings of red and black raspberries effectively controlled annual weeds, both broad-leaved and grasses, without noticeable injury to either the sucker plants of the red raspberry or the new shoots of the black raspberry.

One report on the control of weeds in tree fruits indicates the possibilities of weed control in newly planted sour cherry orchards. CIPC (isopropyl-n-(3-chlorophenyl) carbamate) at 20 pounds and endothal at 15 pounds per acre applied at the base of freshly cultivated cherry trees gave 75-80% weed control and resulted in greatly improved tree growth as compared to trees growing in unsprayed, unweeded plots. Application of 10 pounds of maleic hydrazide to

grasses 12 inches tall was effective in eliminating competition due to such weeds. Both CMU (p-chlorophenyl dimethylurea) to 20 pounds and TCA sodium salt at 25 pounds, although giving excellent weed control, seriously injured the cherry trees.

Weed control studies in gladiolus were reported in one abstract. Pre-emergence applications of 2,4D (2 and 4 pounds), TCA (15 and 20 pounds), TCA in various combinations with PCP-sodium salt, DNOSBP-amine salt (3 and 6 pounds) and endothal (8 pounds) all gave significant control of broad-leaved weeds with 2,4D and DNOSBP being most effective. TCA at 20 pounds and in combinations with PCP eliminated all grasses. Except for a slight delay in flowering with TCA at 20 pounds and TCA (12 pounds) with PCP (8 pounds), flowering in all treatments was equal to that in the control plots. TCA at 20 pounds per acre reduced yield of corms by 10 percent.

Two studies on weed control in nursery stock plantings were received. The following species were found to be tolerant to shielded applications of E.H. No.1 at 4 and 6 lbs. per acre or Stoddard solvent at 75 gallons per acre: Juniperus virginiana, Juniperus procumbens (3rd and 4th year), Syringa and Philadelphus. Papaver orientale was injured by the above herbicides. Weed control was excellent with both materials with E.H. No.1 having somewhat better residual action. In the second study, newly planted 3-year old seedlings of Thuja orentalis were not injured by applications of E.H. No.1 at 4 pounds per acre but leaves were severely bronzed by E.H. No.2 (dichloral urea) at 4 pounds per acre. Weed control with E.H. No.1 was 97% as compared with 25% with E.H. No.2.

Abstracts of Results of Cooperators

Weed control in strawberries (variety Premier) with dinitro-o-sec butylphenol (DNOSBP) Davidson, J. H. Late fall sprays containing emulsions of DNOSBP (phenol) as Dow General were applied on a first year strawberry plantings at the following rates per acre: 0.6 lb., 1.2 lb. and 1.8 lb. Twenty gallons of No. 2 fuel oil and sufficient water to make 135 gallons of spray per acre were applied with each of the DNOSBP concentrations. The principle weed involved was German knotgrass or knawel (Scleranthus annus). Chickweed (Alsine media) and sheep sorrel (Rumex acetosella) were also present. The sprays were applied as an overall application on November 18, 1950 at Benton Harbor, Michigan with the sun shining and a temperature of 55°F. Althought the strawberry foliage was burned to the crown from the fall application, observations in May of 1951 indicated excellent control of all three weed species and very little permanent injury to the strayberries from the 1.8 lb. rate. Control of the weeds was poorer at the lower rates. (The Dow Chemical Co., South Haven, Mich.)

Chemical control of weeds in June-bearing strawberries. Denison, E. L. Yields were taken in 1951 from an experiment of the Dunlap variety on which 2,4D and 8 lb. per acre of sodium 2,4 dichlorophenyl ethelenedioxysulfate(Crag Herbicide 1) had been applied twice to five replications during the 1950 season. No significant reductions in yield were obtained for any of the concentrations of the herbicide. Applications of the herbicide at the same rates were made to this planting following renovation of the bed. All plots showed good renewal of runner plants regardless of treatment. Effective weed control of grasses and broadleafed weeds was obtained with the 4 and 8 lb. treatments. In 1951, 2,4 and 6 lb. per acre of Crag Herbicide 1 and 2 lb. per acre of 2,4-D iso-propyl ester were applied twice (June 19 and July 20) to four replications of spring planted Robinson strawberry plants. Grasses were the principal annual weeds and were controlled effectively by the 4 and 6 lb. treatments of Crag Herbicide 1.

This herbicide was applied to the plots when they were weed free. Rooting of runners was inhibited to the extent of 13, 21 and 54% respectively for the 2,4 and 6 lb. treatments of Crag Herbicide 1. The 2,4-D treatment gave a 63% reduction in rooted runners and following each treatment gave the typical epinastic response. Man hours of hoeing required was reduced by 76% for the 4 lb. treatment of Crag Herbicide 1. Department of Horticulture, Iowa State College.

Chemical control of weeds in everbearing strawberries. Denisen, E. L. Four varieties of everbearing strawberries in three replications were planted in three-row spaced plantings with the rows 12 inches apart and the plants 12 inches apart within the rows. A two-inch layer of chopped corn cobs, as a summer mulch, was placed around the plants one month after planting. Blossoms were removed until June 25 and runners were removed all season. A split plot design was used in which one plot of each variety was used as a check and one plot sprayed with Sodium 2,4 dichlorophenyl ethylenedioxysulfate (Crag Herbicide 1). The herbicide was applied at the rate of 4 lb. per acre prior to mulching and again four weeks later at the rate of 6 lb. per acre. At the time of both applications the plots were weed free. Very effective weed control was obtained. The principal weeds were grasses and elm tree seedlings. Highly significant increases in yield were obtained from the treated plots. Varieties used were Brilliant, Red Rich, Streamliner and Superfection. The average increase in yield of the treatment plots for all varieties was 1,492 quarts per acre. This represents a 16.2% average increase in yield over the check plots. Department of Horticulture, Iowa State College.

Chemical control of weeds in raspberries. Denisen, E. L. Four replications each of new plantings of red (Latham) and black (Bristol) raspberries were sprayed with 2,4 and 6 lb. per acre of sodium 2,4 dichlorophenyl ethylenedioxysulfate (Crag Herbicide 1) on July 6, 1951 after the plots had been cleared of weeds. Very effective control of weeds (principally grasses and pigweed) was obtained with the 4 and 6 lb. treatments, and the 2 lb. treatment had considerable less weeds than the check. There was no noticeable injury to either the sucker plants of the red variety or the new shoots of the black variety compared to the hand weeded check plots. Yields will be taken in 1951. Department of Horticulture, Iowa State College.

Weed control in sour cherry orchards. Gilbert, F. A. and Holm, L. G. A problem which frequently arises in newly planted, cultivated cherry orchards is that of competing broad-leaved and grass weeds during the first 3 to 4 years. To investigate this problem, a 4 replication randomized block experiment was initiated on a Miami sandy loam soil in Door County, Wisconsin. On May 14, 2 Montmorency cherry trees were planted in each block with a guard tree in the row between blocks. A 3 foot strip on either side of the row was sprayed in such a manner that the bases of the trees were hit. The plots were never cultivated, and weed counts were taken on August 24. The predominant weeds in the area were: quack grass (Agropyron repens), barnyard grass (Echinochloa crus-gali), ragweed (Ambrosia elatior), pigweed (Amaranthus retroflexus), lambsquarters (Chenopodium album), and hoary alyssum (Berteroa incana). The following chemicals were applied to freshly cultivated soil at 30 pounds pressure in 40 gallons of water per acre on June 7, at which time the cherry leaves were 3/4 inch long (all concentrations are expressed as acid equivalent or active ingredient): CMU (3-p-chlorophenyl-1-1 dimethylurea) 20 pounds; CIPC (isopropyl-n-(3-chlorophenyl) carbamate) 20 pounds; TCA (sodium salt) 25 pounds; and Niagarathal (disodium 3, 6 endoxohexahydrophthalate) 15 pounds per acre. On July 19, when grasses were 12 inches tall, maleic hydrazide was applied at 10 pounds per acre. CMU, CIPC

TCA, and Niagarathal reduced the weed stands to 0, 23, 6, and 19% respectively of the unweeded control. The number of weeds in the maleic hydrazide plots were equal to those in the unweeded control plots, but growth ceased shortly after spraying and the grass weeds slowly turned brown and offered no further competition to the trees. On August 10, all trees in the TCA plots showed severe injury and 5 of 8 trees in the CMU plots showed mild to severe injury. No injury to trees appeared in any other treatment. The average growth made by trees in the control plots where weeds were undisturbed was approximately 50% of that made under treatments such as CIPC and Niagarathal where weed control was adequate during the period when the most rapid tree growth was occurring. This striking difference is due solely to weed competition. The experiment will be continued and enlarged in 1952. (Contrib. of the Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wis.)

Effects of Certain Herbicides on Strawberry Runner Production and Yields Hemphill, D. D. and Roberts, W. W. EH#1 (2,4-dichlorophenoxy "cellosolve" sulfate), EH#2 (dichloral urea), Endothal (sodium salt), 2,4-D (amine salt) and MH (Maleic Hydrazide) were tested at several rates as herbicides in strawberries in 1950 as preplanting and summer foliage (June and August) treatments. For effectiveness in weed control see Proc. NC WCC 1950. Effects of highest rates of application (the only rates which gave any degree of weed control) on runner production and yields are listed below. Plots treated with EH#1, 4 and 2 pounds (the rates for preplanting and summer foliage treatments respectively), produced 182,473 plants per acre, EH#2 (12 and 6 pounds) 186,086, 2,4-D (2 and 1 pounds) 209,573, MH (12 and 8 pounds) 86,720 plants and Endothal (5 and 2 pounds) 48,780. Lower rates of application decreased runner production to a lesser degree. Check plots produced 218,606 plants per acre. Yields in crates per acre for the above treatments were as follows: EH#1 - 217, EH#2 - 220, Endothal - 71, 2,4-D - 259 and MH - 178. Untreated plots produced 224 crates per acre. A study of runner and yield data of all rates of application shows that yields were not reduced significantly until runner production was reduced from over 200,000 to less than 140, 000 plants per acre in the matted-row system of culture. Under the conditions of this experiment Maleic Hydrazide and Endothal reduced runner production markedly and yields significantly. (Contribution from the Department of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1287.)

Chemical Weed Control Studies in Strawberries - 1951. Hemphill, D. D. and Roberts, W. W. Four chemicals were tested for herbicidal value in a new strawberry planting, variety Blakemore. Four replicated randomized plots, 25 feet in length, were used in each treatment. The weather during the spring and summer was cold and very wet. 2,4-D, amine salt, was used at rates of 2 and 3 pounds acid as pre-planting and at rates of 1 and 1½ as foligae applications (June 18, July 28, Aug. 17) on same plots. EH#1 (2,4-dichlorophenoxy ethyl sulfate) at rates of 4, 6 and 8; EH#2 (dichloral urea) 3,4 and 8; and Sulfasan (Ethyl xanthogen disulfide) 4 and 8 pounds per acre were applied one weed after planting and on June 18, July 28 and August 17. All chemicals were applied in 40 gallons water per acre. Per cent control of weeds four weeks after first treatment was: (1) 2,4-D-2 lbs. 59% broad-leaved, 27% grasses; 3 lbs. 59% broad-leaved, 37% grasses. (2) EH#1 - 4 lbs. 62% broad-leaved, 30% grasses; 6 lbs. 59% broad-leaved, 41% grasses; 8 lbs. 85% broad-leaved, 36% grasses. (3) EH#2 - 4 lbs. 48% broad-leaved, 5% grasses; 8 lbs. 59% broad-leaved, 27% grasses; 3 lbs. (dissolved in alcohol) 60% broad-leaved, 33% grasses. (4) Sulfasan - 4 lbs. 49% broad-leaved, 6% grasses; 8 lbs. - 45% broad-leaved, 21% grasses. Major weeds present were crabgrass (Digitaria sanquinalis) foxtails (Setaria sps.), pigweeds (Amaranthus sps.), lamb's quarters (Chenopodium album).

Second application was made June 18 to a clean field. Even the more promising herbicides gave less than 50% control of weeds at four weeks after treatment. Third application made July 28 to a clean field. Fourth application made August 17. Field had not been hoed after thrid treatment. EH#1 and 2,4-D plots were still relatively free of weeds in late October. Effects of treatments on runner production were as follows: Control - 114,405 plants per acre, EH#1 - 4 lbs. - 105,270, 6 lbs. - 78,735, 8 lbs. - 66,555; EH#2 4 lbs. - 100,920, 8 lbs. - 68,730, 3 lbs. (dissolved) 104,400; 2,4-D 2 & 1 lbs. - 83,085, 3 & 1½ lbs. - 66,990; Sulfasan 4 lbs. - 44,370, 8 lbs. - 43,065. (Contribution from the Department of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1286.)

Chemical weed control in gladiolus. Holm, L. G. and Beck, G. E. On June 10 and 11 White Gold gladiolus corms were planted in 20 foot rows in a 4 replication randomized test on a Miami silt loam soil. The predominant weeds in the area were lamb's quarters (Chenopodium album), pigweed (Amaranthus retroflexus), barnyard grass (Echinochloa crus-gali), and quack grass (Agropyron repens), Weed and stand counts were taken on July 11 and the plots were maintained free from weeds thereafter. Data on flower production were rrecorded on 13 harvest dates during the period August 24 to October 8. The corms were harvested on October 8. On June 18, before emergence of the crop, the following chemicals were applied (all concentrations are in pounds per acre of acid equivalent or active ingredient): 2,4-D (sodium salt) 2 and 4 pounds; TCA (sodium salt) 15 and 20 pounds; TCA 8 pounds mixed with PCP (sodium salt) 4 pounds; TCA 12 pounds with PCP 6 pounds; Pre-Merge (DNOSBP-amine salt) 3 and 6 pounds; and Miagarathal (disodium 3,6, endoxohexahydrophthalate) 8 pounds. All of the treatments provided significant control of broad-leaved weeds. 2,4-D and 4 pounds and Pre-Merge 6 pounds were most effective; providing a reduction in weed stands of 75 to 80 percent. TCA alone and in combination with PCP reduced stands of these weeds by about 50 percent. TCA 15 pounds and Miagarathal 8 pounds gave 75 to 80% control of grasses while TCA at higher concentrations and in combinations with PCP eliminated all grass weeds in the area. A slight delay in flowering resulted in the treatments with TCA 20 pounds and TCA 12 pounds mixed with PCP 8 pounds, but the total number of flowers produced in all treatments was essentially the same as in the control plots. The treatments did not interfere with the number of corms produced and only TCA 20 pounds resulted in a yield of corms lower than that of the control. The reduction in this case was 10 percent. These data confirm results obtained in 1950. (Contribution of the Department of Horticulture, University of Wisconsin, Madison, Wis.)

The effect of 2,4-D and EH_1 on Premier Strawberries. Holm, L. G. and Gilbert, F. A. Premier strawberries were planted in a 6 replication randomized test on May 2 in a Miami sandy loam soil. On June 7, just as runner production was initiated, the plots were hoed and 2,4-D (sodium salt) 1 and 2 pounds of acid equivalent, and EH_1 (sodium dichlorophenoxyethyl sulfate) 3 and 6 pounds of active ingredient per acre were applied at 30 pounds pressure in 40 gallons of water per acre. Another set of plots received 1 pound per acre of 2,4-D and still another 3 pounds per acre of EH_1. On July 7, these latter plots were hoed and re-treated with their respective chemicals at the same concentrations. Four-hundredths of an inch of rain fell during the 72 hours following the first treatments and 2.25" fell in the 72 hours following the second application. The total rainfall for the season was as follows; June, 2.17", July, 4.14", August, 4.25", and September, 4.04". The plots were kept free from weeds and were hoed on July 25 to promote rooting of runner plants. All 2,4-D treatments caused temporary wilting of the plants for 3 to 7 days. Total runner production was equivalent to that of the control with the exception that EH_1 6 pounds and 2,4-D 2 pounds

reduced runner production by 10 and 20 percent respectively. The average number of runners on each plant which had produced one or more runner plants at the time the data were recorded was equivalent to that of the control in all treatments with the exception that 2,4-D 2 pounds caused a reduction of 33 percent. Preplanting treatments with Niagrathal (disodium 3, 6 endoxohexahydrophthalate) 8 pounds, Pre-Merge (DNOSBP-amine salt) 10 pounds, and PCP (sodium salt) 10 pounds per acre of active ingredient reduced runner production and injured the plants quite severely. Post-planting treatments with CIPC (isopropyl-n-(3-chlorophenyl) carbamate) 10 and 15 pounds and CMU (3-p-chlorophenyl-1-dimethylurea) ½ and 3 pounds per acre severely injured the plants. (Contribution of the Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wis.)

Effects of the amine and non volatile ester of 2,4-D treatments to Dakota and Dunlap strawberries. Howat, M. G. Plots of Dokota and Dunlap strawberries previously treated with 2,4-D in 1950 were sprayed on May 21, 1951 to plants completing the spring dormancy stage. The amine and the non volatile ester of 2,4-D was applied with a plot sprayer at 4 rates, viz: ¼, ½, 3/4 and 1 lb. of acid equivalent per acre. Growing conditions were excellent. Flowering began an average of 16 days later in Dakota and 12 days later in Dunlap. In Dakota all treatments caused slight stem curl deformities. In Dunlap all treatments except the ¼ and ½ lb. rate of the amine of 2,4-D caused slight stem curl deformities. However, by July 9, when berries began to ripen, both Dakota and Dunlap had outgrown almost all indications of stem deformities. The 1 lb. treatment of non volatile ester apparently caused the formation of about 10 percent sterile flowers, and approximately 20 percent of the flowers dried up not forming fruit. Both formations of 2,4-D at the ½ lb. rate killed Amaranthus retroflexus, Chenopodium album, Brassica spp., and Salsola pestifer. The non volatile ester of 2,4-D at 3/4 and 1 lb. controlled all weeds except grasses and dandelions. The amine of 2,4-D was not quite as effective in weed control. In comparison to applications of 2,4-D made in 1950 at a later date the effects on the strawberries were much less. (Dominion Experimental Station, Scott, Sask.)

Further developments in weed control in established nursery stock. Mahlstede, J. P. Thirty-six plots (80 square feet per plot), superimposed on a Webster type soil containing Juniperus virginiana L., Juniperus procumbens Sub. and Zuco. (3rd and 4th year), Syringa, Philadelphus, and Papaver species (2nd year) were treated with three herbicides in the spring and summer of 1951. Each treatment was applied with a low pressure sprayer, utilizing a covered boom to minimize drift. The materials and concentrations used in these tests were: Crag Herbicide 1 (Sodium 2,4-dichlorophenylethylenedioxysulfate) at the rate of 4 and 6 lbs. per acre, EH_2 (Dichloral urea) at the rate of 4 and 6 lbs. per acre, and Stoddard solvent applied at the rate of 75 gallons per acre. The entire experiment of six replications was hand hoed June 29 and July 25, prior to each spray application. Crag Herbicide 1 (4 and 6 lbs. per acre), and Stoddard solvent (75 gal. per acre) gave 90% control of all broad and narrow leaf weeds to July 25. The control effectiveness of the July 25th application of Crag Herbicide 1 (4 lb. per acre) and Stoddard solvent (75 gal. per acre0 was reduced to 79% and 21% respectively by the end of the growing season. EH_2 at 2 lb. and 4 lb. per acre rates did not significantly reduce the weed population in any of the six plots. Fall observations indicated tolerance of all treated plant material, except Papaver orientale to soil applications of the chemicals utilized in these trials. Hand labor was reduced by one-half where Crag Herbicide 1 was used at the rate of 6 lb. per acre. (Horticulture Department, Iowa Agricultural Experiment Station, Ames, Iowa)

The control of weeds in conifer transplant beds. Mahlstede, J. P. Three year old seedlings of Thuja orientalis L. transplanted in beds in the spring of 1951, in a sandy loam soil were sprayed with Crag Herbicide 1 (Sodium 2,4-dichlorophenylethylenedioxysulfate) and EH-2 (Dichloral urea) at the rate of 4 pounds per acre on June 23 and July 21. The entire experiment consisting of four replications, with 30 seedlings per plot was hand weeded prior to the first herbicide application on June 23. Crag Herbicide 1 (4# per acre) gave 97.3% control of such weeds as chickweed, peppergrass, purslane, and shepherd's purse, which were the principal weeds in the check plots. No injury to the plants was evident in the Crag Herbicide 1 plots at the end of the growing season. Application of EH-2 resulted in only 25% control of weeds, and severe bronzing of the foliage was evident in fall observations. (Horticulture Department, Iowa Agricultural Experiment Station, Ames, Iowa.)

Fruiting of nine varieties of June-bearing strawberries as influenced by 2,4D applications. Nylund, R. E. Nine varieties of strawberries (Minnesota selections #1361, 1650, 1536, 1395, 1584, and Dunlap, Beaver, Arrowhead, and Burgundy) planted on May 24, 1950 in a clay loam soil were sprayed with 2,4D ester (isopropyl) at the rate of 1 pound acid per acre on July 5 and again on July 18, 1950. Each variety was planted in single row plots 48' long and replicated four times. Each variety plot was split for the comparison of 2,4D vs. no herbicide. Yields obtained during the first fruiting year (1951) indicated no differences in yields between sprayed and unsprayed plots. Likewise, the varieties did not respond differentially to the 2,4D treatments. (Paper No. 2734 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station).

Project IV. Control of Weeds in Vegetable Crops, Potatoes, Sugar Beets, Small Fruits and Ornamentals.

Sugar Beets

B. H. Grigsby

Summary

Pre-emergence treatments for weed control in sugar beets were the subject for 9 of the 13 abstracts received. In the 4 other abstracts post-emergence treatments with some of the chemicals used in the pre-emergence treatments were made to determine tolerance of beets and effectiveness on weeds. The chemicals used indicate that most investigators were concerned with the control of annual grasses.

Both the calcium and sodium salts of TCA were used in most of the trials as were IPC, CMU, 3, 6, endoxohexahydrophthallate and dichloral urea. A number of compounds designated only by the manufacturer's code numbers were used by various investigators. Rates of application used were quite uniform throughout the trials but soil and climatic data are not given in most of the reports. This is unfortunate in that such data would be very helpful in trying to interpret the variations in results which are apparent.

The results indicate that throughout the region, TCA, at rates of 5 to 10 lbs./A generally gave the best control of grasses, especially Setaria spp., with least injury to sugar beet stands. There appears to be no significant differences between the sodium and calcium salts of this compound. However, one or two reports indicate slight differences in beet tolerance at rates in excess of 8 lbs./A.

Control of weeds was generally obtained with IPC at 8 and 16 lbs./A but some reduction in vigor of beets was found at these rates. Chloro IPC was no more effective than IPC and appears to have caused some stunting of beets at rates which gave satisfactory weed control.

Data on the response of wild oats were presented in two of the abstracts, both of which indicate that IPC is effective for the control of this weed. Endothal and maleic hydrazide are also reported to have given control of wild oats, the latter compound, however, was used only in greenhouse experiments.

Results obtained with CMU at most stations showed that 1 lb./A of this compound was an effective treatment for the control of germinating weed seedlings but the sugar beet seedlings were also destroyed. Results obtained in Ohio did not show weed control at this rate.

Dichloral urea and EC 3890 were the only other compounds that showed any promise and these require further experimentation.

The data from post-emergence treatments were less extensive but show that TCA at rates of 10 to 15 lbs./A may give some control of both broad leaved and grass weeds. Such treatments usually caused some injury to beet foliage. Endothal was reported to be effective on weeds other than lamb's quarters in a number of the reports. Yield data are too fragmentary to warrant any conclusions.

The results obtained in 1951 indicate that TCA, at 5-10 lbs./A, is the best material now available for pre-emergence weed control in beets, except where wild oats are present. In the latter case, IPC appears to be more satisfactory. Yield data, are needed for more complete evaluation of both compounds. Dichloral urea, Endothal, and sodium trichloroacrylate (E.C. 3890) show some promise.

Pre-emergent chemical weed control in sugar beets. Andersen, E. T., Shadbolt, C. A. and L'Arrivee, J. C. M. The following chemicals were applied in spray form to sugar beet plots one day previous to emergence of the beets: EH 5722, Chloro IPC, IPC, EH 5476 and EH 2-73 all at 4, 8, and 16 lbs. per acre; EC 3890 at 4, 8 and 12 lbs; Endothal at 5, 10 and 15 lbs. and CMU at 1/2, 1, 2 and 4 lbs. per acre. Weeds present were: pigweed (Amaranthus retroflexus), stinkweed (Thlaspi arvense), wild buckwheat (Polygonum convolvulus), wild mustard (Brassica arvense) and green foxtail (Setaria viridis). Except where otherwise stated, no injury to the sugar beets was caused by any of the chemicals. EH 5722 gave no control of weeds at the 4 and 8 lb. rates and only slight control was obtained with the 16 lb. treatment. Chloro IPC gave 0. 40 and 65% control of weeds at the rates used respectively. However, injury to the beets was observed with the two highest rates. IPC gave fair control of the weeds at 4 lbs., 65% control at 8 lbs. and 16 lbs. destroyed all weeds except lamb's quarters. EH 5476 and EH 2-73 had no effect on weeds or beets at the rates used. EC 3890 gave only fair weed control at the 12 lb. rate. All three rates caused injury to the beets in the form of stunting, hyponasty and narrowed leaves. Endothal gave no control at the 5 lb. rate. The 10 and 15 lb. rates destroyed all broad leaf weeds except lamb's quarters. CMU showed no control at the 1/2 lb., very slight control at 1 lb., 2 lb. controlled the weeds, but also produced an uneven stand of beets. The 4 lb. treatment gave good control of weeds but reduced the beet stand to less than 50%. (Contrib. of Div. of Plant Science, Univ. of Manitoba, Winnepeg.)

Greenhouse tests with Maleic Hydrazide as a herbicide. Andersen, E. T. and Martin, J. Maleic hydrazide, in various ways, was applied at the rate of 50 gal. of solution per acre to sugar beets and weeds sown in flats in the greenhouse. Plants used were sugar beets, wild oats (Avena fatua), green foxtail (Setaria viridis), mustard (Brassica arvensis), lamb's quarters (Chenopodium album), wild buckwheat (Polygonum convolvulus), and pigweed (Amaranthus retroflexus). All weeds survived and made good growth when sprayed with a 4 lb. per acre rate 3 days after seeding; sugar beets were seriously damaged. At 12 lb. per acre all weeds were controlled except pigweed, most of which recovered. When MH was sprayed and mixed into the upper 1 1/2" of soil previous to seeding, it proved more effective as a herbicide. In this manner a 2 lb. rate controlled the mustard, green foxtail, and sugar beets; a 4 lb. rate the wild oats; and an 8 lb. rate the buckwheat, lamb's quarters, and pigweed. Greater damage was caused to the plants and germination was reduced when flats treated in the preceding manner were watered after seeding and placed out of doors at below freezing temperatures for 6 weeks prior to exposure to greenhouse growing conditions. (Contribution of the Division of Plant Science, University of Manitoba, Winnipeg.)

Post-emergent chemical weed control in sugar beets. Andersen, E. T., Shadbolt, C. A. and L'Arrivee, J. C. M. The following chemicals were tested on duplicate plots of sugar beets: Sodium salt of Endothal (Niagarathal. W) at 2, 4 and 8 lbs., EH 5722 and EH 5476 both at 8, 12 and 24 lbs., EH 2-73 at 4, 8 and 16 lbs., and sodium isopropyl xanthate (NIX) at 8, 12 and 24 lbs. per acre. The predominant weeds at the time of application were: wild mustard (Brassica arvense), pigweed (Amaranthus retroflexus), stinkweed (Thlaspi arvense), wild buckwheat (Polygonum convolvulus) and cultivated oats. The sugar beets were in the 2 to 4 true leaf stage. Observation 3 weeks later indicated that the Endothal gave 20, 60 and 85% control of weeds at the 3 rates respectively. The sugar beets were seriously affected, although they recovered considerably, at the 2 lb. rate. This chemical seems to have little selectivity for use, post-emergently, at 2, 4 and 8 lbs. per acre. EH 5722, EH 5476 and EH 2-73 had no pronounced effects on either

the weeds or beets. NIX gave very good control of broad leaf weeds, however, all rates severely injured the beets. It did not noticeably injure the oats. (Contribution of the Division of Plant Science, University of Manitoba, Winnipeg.)

TCA for weed control in sugar beets. Andersen, E. T., Shadbolt, C. A. and L'Arrivee, J. C. M. Post-emergent applications of calcium and sodium salts of TCA were made on sugar beets. Rates of application were 0, 5, 7-1/2, 10 and 20 lbs. per acre. The beets at the time of application were in the 2 to 4 true leaf stage. The predominant weeds were: red root pigweed (Amaranthus retroflexus), wild mustard (Brassica arvense), stinkweed (Thlaspi arvense) and green foxtail (Setaria viridis). Observations made 3 weeks later indicated that the 5 lb. rate of both TCA salts was ineffective. The 7-1/2 and 10 lb. rates gave fair weed control and the highest rate gave good control of most weeds including cultivated oats. Lamb's quarters were not controlled. The sodium salt at the 10 and 20 lb. rates caused stunting and hyponasty of the beet leaves, whereas the calcium salt at the same rates showed only very slight effect. Similarly, a pre-emergent experiment using the two salts at 0, 5, 7-1/2, 10 and 15 lbs. per acre applied 4 days after the sowing of the beets was carried out. Observations made a month later showed that the 5 and 7-1/2 lb. rates had produced little effect on the weed stand. The 15 lb. application had reduced the weeds by approximately 50%. The beets were not injured at any of the rates with either chemical. There was a proportional decrease in weight of weeds as the rate of both salts was increased. (Contribution of the Division of Plant Science, University of Manitoba, Winnipeg.)

Control of Weeds in Sugar Beets. A. L. Bakke, D. W. Staniforth and D. B. Ogden. Sugar beets planted on June 6 were treated on June 8 with TCA, sodium salt, TCA, calcium salt, Chloro IPC, E. H. 5722, all at 0, 4, 8 and 16 lbs. per acre. EH 2, Niagarathal 009 (N-1-Naphylphthalamic acid) at 0, 2, 4 and 8 lbs. per acre, and CMU at 0, 1/2, 1 and 2 lbs. per acre. Sugar beets were tolerant of both forms of TCA. TCA sodium salt, TCA calcium salt had a high herbicidal rating at 8 and 16 lbs. There was no reduction in yield with CMU, TCA, sodium salt, TCA, calcium salt, and EH 5722. The percent sugar was practically the same throughout the experiment. In an exploratory trial with a mixture of TCA 4 lbs. and CMU 1/2 lb., the yield was higher than the general average of the controls. (Contribution of the Iowa Agricultural Experiment Station.)

Pre-emergence treatments for weed control in sugar beets. B. H. Grigsby. Eight chemicals, each at three rates in 40 gal. of water (except Oktone which was applied in diesel oil) were applied two days before the expected time of beet emergence. The experiment was made on beets planted May 11 and June 7. Effects of the herbicides on beet emergence at the two planting times was not essentially different but effects on weed emergence were greatest at the June planting. TCA, at 7-1/2 lbs./A was the most effective herbicide used and there were no significant differences between the calcium and sodium salts. Dichloral urea, at 8#, was almost as good. Niagarathal (3, 6-endoxohexahydrophthalate) gave satisfactory control at 6 and 8 lbs. Endothal, another formulation of this chemical, was not effective at the early planting but gave good weed control in June. Some beet stand reduction was found at the most effective rates. IPC, at rates sufficient for weed control, i. e., 8 and 16 lbs. caused some stunting of beets. CMU at 1/4, 1/2, and 1 lb., gave good weed control but completely suppressed beet emergence at the 1 lb. rate and caused an 80% reduction at 1/2 lb.

In another experiment, TCA, Na salt, and PCP, Na salt, were applied at the

rate of 8 lbs./A. Both compounds were effective for the control of foxtail and other annual grasses. PCP produced a stand reduction of 50% while TCA had no effect on beet stand. Early germinating nut grass was also destroyed by TCA. (Contribution from the Mich. Agric. Exp. Sta. and Div. of Weed Invest., B.P.I.S. & A.E.)

Pre-emergence control of annual grasses in sugar beets. Kratochvil, D. E. and Holgeson, E. A. Nine chemicals were applied pre-emergence to sugar beets. The chemicals were applied in 40 gallons of water per acre using two nozzle, oil cleaner sprayers, and treating the middle two rows of a four row plots 20 feet long. Cut worms and poor germination eliminated the possibility of securing results of the beet response; however, counts and vigor estimations were made on the annual grasses of the area. Sodium TCA, Calcium TCA, and E. C. 3890, all at 16 lbs./A., eliminated 80 percent or more of the annual grasses and the remaining grass plants were stunted. These plots remained nearly free of grasses for the entire growing season. The two TCA formulations gave excellent grass control at 8 lbs./A. Endothal, Niagarathal-W (powder formulation of 3, 6, endoxohexahydrophthalate), E. H. 5722, and Chloro-IPC at 8 pounds per acre gave fair grass control. CMU (3-p-chlorophenyl-1, 1 dimethylurea) up to 2 lbs./A. showed no grass control. N-1-naphthyl phthalamic acid at 2 and 4 lbs./A. gave fair grass control. From this experiment, TCA and E. C. 3890 appear to be the only chemicals showing promise for pre-emergence grass control. (Contributed by Div. of Weed Investigations, B.P.I.S. & A.E., U.S.D.A., and North Dakota Agricultural Experiment Station.)

Post-emergence control of annual grasses in sugar beets. Kratochvil, D. E. and Holgeson, E. A. Ten chemicals and three combinations of chemicals were applied post-emergence to Setaria infested sugar beets. Cut worms and poor germination eliminated a high percentage of the sugar beets before results could be obtained. Annual grasses had 7 to 8 true leaves and 1 to 2 tillers. Chemicals were applied in 40 gallons of water per acre to 3 applications of two rows 20 feet long. Stand counts and vigor estimations were made on the annual grasses. Sodium TCA at 8 and 16 lbs./A. showed the best results with herbicidal ratings of 840 and 970 out of a possible 1000 respectively (based on L. M. Stahler's method of calculating a Herbicidal Rating, N.C.W.C.C., 1949 Proceedings). Calcium TCA at 16 lbs./A. showed a rating of 850. The remaining grass plants in the TCA plots were stunted and of very little competition to beet plants in the plots. Endothal at 8 lbs./A. showed a rating of 930. The remaining grass plants in these plots were held to the soil by only 1 or 2 roots. This seems to be one of the characteristic injuries of Endothal to grass plants. The combination of Endothal 2 lbs./A. plus sodium TCA at 8 /A. showed a rating of 885. A later planting of sugar beets indicated tolerance of rates of TCA, or Endothal at which grass control was obtained. Niagarathal-W (powder formulation of Endothal) at 2, 4 and 8 lbs. CMU (3- p-chlorophenyl-1, 1 dimethylurea) at 1/4, 1/2, 1 and 2 lbs. chloro-IPC at 2, 4, and 8 lbs. N-1 naphthal-phthalamic acid at 1 lb., and E. H. No. 2 at 2, 4, and 8 lbs. did not show any appreciable degree of grass control. (Contributed by Div. of Weed Invest., B.P.I.S. & A.E., U.S.D.A., and North Dakota Agricultural Experiment Station).

Pre-emergence weed control in sugar beets with CMU. Soxsmith, J. J. CMU (3-p-chloro-phonyl-1, 1-dimehylurea) was applied as a pre-emergence treatment to sugar beets, five days after seeding, at rates of 1 and 2 pounds per acre. Excellent weed suppression resulted from both treatments for a period of one month. Three months after treatment there were few weeds present on areas treated at the 1 pound rate, the control estimated at 85 to 90 per cent. At this same time the 2 pound rate had given an excellent control of weeds, estimated at 98 per cent. Beet stands were seriously reduced by the CMU treatments tested, 75 per cent reduction caused by the 1 pound rate and 90 per cent reduction by the 2 pound rate. (Contribution by Dominion Experimental Station, Lethbridge, Alberta.)

Evaluation of several herbicides as aids to weed control in sugar beets. Nelson, Russell T. Herbicides tested as pre-emergence and post-emergence applications to sugar beets included TCA as sodium and calcium salts at 5 - 15 lbs., IPC and Chloro IPC (both emulsifiable) at 4 - 16 lbs., E.H. 5722 at 4 - 16 lbs., E.H2 at 1-1/2 - 30 lbs., CMU at 1/4 - 3 lbs., ME.3003 and Niagrathal (Endothal) at 2 - 8 lbs., E.C.3890 at 4 - 8 lbs., 6Q8 phthalamic derivative at 2 - 8 lbs., Xanthogen disulfide at 7-1/2- 30 lbs., and Chlorosol-A at 50 lbs. Aid in controlling weeds, without serious injury to beets, was obtained in certain cases with the salts of TCA, E.H.2 (dichoral urea) and IPC and endothal formulations. Of the other herbicides tested CMU and 6Q8 were found to be very effective phyto-toxins, but killed both weeds and sugar beets in young stages of development. In supplemental experiments, control of volunteer small grains and wild oats was obtained consistently with IPC and E.H.2 when applied uniformly to the soil surface and immediately double-disced into the soil to a depth of 4- 6 inches. This pre-planting treatment was made prior to germination of the oat, barley and wild oat seeds infesting the soil and just prior to final seedbed preparation. Used in this manner, IPC (emulsifiable) at 3 and 6 lbs. per acre gave fair and excellent control, and E.H.2 at 10 and 20 lbs. per acre gave poor and good control, respectively. Sugar beets planted on the same day that the herbicidal applications were made grew well, though the E.H.2 at the higher rate caused an apparent yellowing of the sugar beet leaves. (Contribution from the Great Western Sugar Company, Agricultural Experiment Station, Longmont, Colorado.)

Pre-emergence weed control in sugar beets. White, W. W. and Willard, C.J. Duplicate experiments were made at Lindsay, Ohio and Columbus, Ohio. Several additional herbicides were used at Columbus. Herbicides were applied in 40 gallons of water per acre. At both locations TCA was by far the most effective material used, 7½ -10 lb./A. resulting in control of Setaria spp. and Polygonum spp. 5 lb./A. was almost enough. Some stunting of beets occurred at 15 lb./A. but beets recovered normal size and color in 4-5 weeks after spraying. Calcium TCA had the same effect on the weeds present as the sodium salt, but was slightly more toxic to beet seedlings. At Lindsay, chloro IPC at 2 and 4 lb./A. was similar to TCA, at Columbus 8 lb./A. were required to produce similar results with some damage to beets. E. C. 3890 (sodium trichloroacrylate) at 6 lb./A. gave 75% control of foxtail, but caused severe damage to beets at 8 lb./A. E. H. 2-73 (dichloral urea) was effective against foxtail at 8 lb./A. with little damage to beets. M.E. 3003, Niagarathal, E. C. 3740, (three formulations of 3,6-endoxohexa-hydrophthalate), CMU at ¼, ½, 1 and 2 lb./A., 8Q6 (Phthalinil from U. S. Rubber) and IPC, up to 8 lb./A. showed no effect on anything. N-1-naphthyl phthalmic acid and N-2-chlorophonyl phthalmic acid stunted beets by the two true leaf stage, very little recovery had been made 8 weeks after treatment. These herbicides showed promise as grass killers. Another experiment, given normal cultivation and hoeing, was conducted strictly for effects on yield of beets, included sodium and calcium TCA at 5, 7½, 10, and 15 lb./A., and

M.E. 3003 and Niagarathal at 2, 4, and 8 lb./A. None of these treatments resulted in a significant increase or decrease in yield. (Contribution from Ohio Agricultural Experiment Station.)

Effects of post-emergence application of herbicides on sugar beets. Kratochvil, D. E. and Helgeson, E. A. Application of several herbicides were made to sugar beets at the 7-10 leaf stage. The beets had been hand thinned and hand weeded prior to treatment. All chemicals were applied in 40 gallons of water per acre in three replications of 4 rows, 20 feet long. Stand counts and vigor estimations were made 1 month after treatment. TCA, either the sodium or calcium salt, at 4, 8, and 16 lbs. per acre caused no injury to the beets and no reduction in stand. Sodium salt of TCA at 32 lbs. per acre, reduced the stand of beets to 86% of check and stunted the remaining beets. Sodium salt of 3, 6 endoxohexahydrophthalate (Endothal M.E. 3001), E.H. 5722, Chloro-IPC and E. H. No. 2, at rates of 2, 4, or 8 lbs. acid per acre, showed no injury to the beets either in stand or vigor. E. C. 3890 at 1, 2, and 4 lbs. per acre and Niagarathal-W (Endothal formulation) at 2 lbs. per acre showed no injury to beets; however, Niagarathal-W at 4 and 8 lbs. reduced the stand and stunted the beets. CMU (3-p-chlorophenyl-1, 1 dimethyl-urea) at 1 and 2 lbs. and E. H. 5722 at 16 lbs. injured the beets by reduction of both stand and vigor. Combinations of Endothal (M. E. 3001) 2 and 4 lbs. plus TCA, Chloro-IPC, and E. H. 5722 at 2, 4, and 8 lbs. showed no appreciable injury to beets. Endothal (M.E. 3001) at rates of 2, 3,4, 5, 6, and 8 lbs. per acre plus 10 drops of Du Pont's Spreader-Sticker per treatment showed no appreciable injury to beets either in stand reduction or vigor and at 4 to 8 lbs. gave very promising results for elimination of wild oats (Avena fatua). (Contributed by Div. of Weed Invest., BPISAE, U.S.D.A., and North Dakota Agricultural Experiment Station.)

Dates and rates of application of 3, 6 endroxohexahydrophthalate to sugar beets. **Kratochvil, D. E. and Helgeson, E. A.** Randomized plots of sugar beets 4 rows wide by 20 feet long were treated at the cotyledonary to 3 leaf stage, 4 to 6 leaf stage, 7 to 10 leaf stage, and 9 to 12 leaf stage of growth with 2, 4, and 8 lbs. of Endothal (M.E. 3001) per acre, and 4 lbs. of Endothal plus 10 drops of Du Pont's Spreader-Sticker. All applications were made in 40 gallons of water per acre. Stand counts and vigor estimations were made about 1 month after treatment showed no appreciable reduction for the first three dates of treatment. The last date of treatment was severely burned, causing both a sharp reduction in stand and vigor. These plots seem to recover after a period of 2 months; however, yield data indicate a reduction of 2.75 tons per acre for the 2 lb. rate, 3.5 tons for the 4 lbs. rate, 4.? tons for 8 lbs., and 5.65 tons for 4 lbs. plus Spreader-Sticker. This last treatment was made the day following a 1.14 inch rain and during a period of high relative humidity, whereas the other treatments were made during warm, moderately dry weather. Reduction in yield for the 1st, 2nd, and 3rd dates of treatment were slight, ranging from less than one ton per acre for 4 lbs. at the 7 to 10 leaf stage to 2.7 tons for 8 lbs. at the 4 to 6 leaf stage of growth. The promising results that were obtained during the 1951 season in eliminating wild oats by applications of 4 to 8 lbs. of Endothal warrant further investigations of this chemical. (Contributed by Weed Investigations, B.P.I.S. & A.E., U.S.D.A., and North Dakota Agricultural Experiment Station).

Project IV. Control of Weeds in Vegetable Crops, Potatoes, Sugar Beets, Small Fruits, and Ornamentals.

Sweet Corn and Potatoes — L. G. Holm

Summary

Four abstracts covering weed control in potatoes and three on sweet corn were received and the summary is thus based upon this limited number of reports.

One report of the use of 2,4-D on potatoes at 6 ounces and 1 pound per acre as a post-emergence treatment applied in such a way as to obtain a minimum wetting of the crop resulted in a slight deformity of the leaves at the lower rate and considerable deformity together with a reduced yield at the higher rate. Additional work with pre-emergence sprays has shown the dinitro compounds, pentachlorophenol, and Endothal (3, 6, endoxohexahydrophthalate) to be effective for weed control at concentrations which have not interfered with plant growth and yields. TCA (sodium salt) appears to be effective against grasses on both organic and mineral soils with no injury to the potatoes. In the appropriate concentration MCP, mixtures of 2,4-D and 2,4,5-T, and several formulations of 2,4-D are reported to be effective as pre-emergence treatments. Successful use of this group of compounds requires adequate consideration of variety of crop and formulation and concentration of the chemical. In general, concentrations over 1 pound per acre produced injury to the crop in 1951.

Post-emergence treatment of sweet corn with 2,4-D six weeks after planting is reported to be satisfactory if applied in such a manner as to shield the plant from the spray as much as possible. Slight deformation to late-forming cobs was reported at high concentrations. Sodium cyanate shows little promise as a pre-emergence treatment for corn, while 2,4-D is again reported to give fair weed control without injury to the crop. CMU applied to sweet corn 5 days after planting gave excellent weed control for an extended period. Reliable data on the effect of this chemical on growth and yield of sweet corn has not been reported.

Abstracts of Results of Cooperators

Pre-emergence weed control in potatoes on organic soils. Holm, L. G. Russet Sebago potatoes were planted on an organic soil in a 3 replication randomized block test on June 19. The predominant weeds in the area were pigweed (Amaranthus retroflexus), smartweed (Polygonum sp.), and barnyard grass (Echinochloa crus-gali). All of the sprays were applied on June 25 and 0.5 inches of rain fell during the ensuing 72 hours. Weed and stand counts of the potatoes were taken July 9 and the plots were maintained free from weeds thereafter. Harvest was on September 5. The following chemicals were applied at 30 pounds pressure in 40 gallons of water per acre (all concentrations are in pounds per acre of acid equivalent or active ingredient): TCA (sodium salt) 15 and 20 pounds; PCP (sodium salt) 15 and 20 pounds; TCA 12 pounds mixed with PCP 4 pounds; Niagarathal (disodium 3, 6, endoxohexahydrophthalate) 8 pounds; Pre-Merge (DNOSBP-amine salt) 8 pounds; 2,4-D (sodium salt) 2 pounds; and MCP (diethanolamine) 2 pounds. All of the treatments significantly reduced the weeds in the plots but they were grouped as to effectiveness in the following manner: TCA 15 and 20 pounds, TCA 12 plus PCP 4 pounds, PCP 15 pounds, Niagarathal 8 pounds, and MCP 2 pounds gave 65 - 70 percent control; Pre-Merge 8 and PCP 20 pounds gave 75 and 82 percent control respectively. 2,4-D was not effective in this test. Stands of potatoes were not injured and all plots yielded

as well or better than the control. In another replicated test, TCA was applied at 15 and 30 pounds per acre to a solid quack sod (freshly torn) on a silt loam soil one month before Pontiac potatoes were planted. This treatment provided effective control of the quack grass for the major portion of the season, while at the same time allowing normal development of the potatoes. (Contrib. of the Dept. of Hort., University of Wisconsin, Agricultural Experiment Station, Madison, Wis.)

The effect of 2,4-D as a post-emergence treatment on sweet corn. Howat, M. G. One application of the amine of 2,4-D at the rates of $\frac{1}{4}$, $\frac{1}{2}$, and 1 pound of acid equivalent per acre was sprayed as a post-emergence treatment on July 13 to Dorinny corn planted on May 30. The nozzle of a knapsack sprayer was directed to make a complete coverage of the ground and yet to keep the amount of herbicide applied to the plant stems at a minimum. The yield and earliness of all treated plots compared very closely to that of the check plot. Among the late forming cobs the 1 pound rate of application apparently increased the formation of flat cobs containing only four rows, thereby increasing the percentage of unmarketables. Although of no consequence, kinking of the pedicle also was observed on cobs borne on tillers from the plots treated with the 1 pound rate, and to a very slight extent similar kinking was found to result from the $\frac{1}{2}$ pound treatment. (Contrib. of the Dominion Experimental Station, Scott, Sask.)

The use of 2,4-D as pre- and post-emergence treatments in potatoes. Howat, M. G. The amine of 2,4-D was applied as a pre-emergence treatment at the rates of $\frac{1}{2}$, 1, and 2 pounds and as a post-emergence treatment at the rates of 6 ounces and 1 pound acid equivalent per acre to Irish Cobbler potatoes planted May 31. All pre-emergence treatments delayed growth and caused typical 2,4-D injury to all except the top growth of the plants which was made later in the summer. Late in the season the 1 and 2 pound rates had reduced the plant vigor 40 percent. The 2 pound treatment caused a 24 percent reduction in marketable weight and considerable reduction in grade since many tubers were small in size as compared to the check. The $\frac{1}{2}$ and 1 pound treatments were equal to the check in yield and grade. The post-emergence treatments were made on July 13 when the potatoes were in the pre-bloom stage. The spray nozzle of the knapsack sprayer was directed to make almost a complete coverage of the ground and yet to keep the amount of herbicide applied to the base of the plant at a minimum. The 6 ounce rate caused slight deformities to 5 percent of the upper leaves. The 1 pound rate caused slight deformities to 30 percent of the upper leaves, a slight reduction in plant vigor and approximately 10 percent reduction in marketable yield. The grade of tubers from both treatments and the yield from the 6 ounce treatment compared favorably with the check. (Contrib. of the Dominion Experimental Station, Scott, Sask.)

Pre-emergence weed control in sweet corn. Meador, D. B. and Hemphill, D. D. Sodium cyanate 2 pounds and 4 pounds per acre and 2,4-D (amine salt) $1\frac{1}{2}$ pounds per acre each were applied to 4 replicated randomized plots of sweet corn 2 days after planting. Weed control 4 weeks after treatment was: (1) sodium cyanate 2 pounds - 22.4 percent broad-leaved, 24.2 percent grasses; (2) sodium cyanate 4 pounds - 30 percent broad-leaved, 20 percent grasses, and (3) 2,4-D $1\frac{1}{2}$ pounds - 67.3 percent broad-leaved, 63.1 percent grasses. Major weeds present were crabgrass (*Digitaria sanguinalis*), foxtail (*Setaria sps.*), pigweed (*Amaranthus retroflexus*), and ragweed (*Ambrosia artemisiaefolia*). No noticeable phytotoxicity occurred. Average yields of plots were: sodium cyanate 2 pounds - 13.9 pounds, sodium cyanate 4 pounds - 11.4 pounds, 2,4-D - 13.9 pounds, and checks 12.2 pounds. Because of the large amount of rainfall, little cultivation could be done. All plots contained an abundance of weeds at harvest, especially weedy were the control plots. (Contrib. of the Department of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1280.)

Pre-emergence weed control in potatoes. Meador, D. B. and Hemphill, D. D. Pentachlorophenol, sodium salt (PCP) 12 pounds per acre and 2,4-D (amine salt) 1½ and 2 pounds per acre each were applied to four replicated randomized plots of potatoes 5 days after planting. Weed control 4 weeks after treatment was: (1) PCP - 87 percent broad-leaved, 0.0 percent grasses; (2) 2,4-D 1½ pounds per acre - 86 percent broad-leaved, 45 percent grasses; (3) 2,4-D 2 pounds per acre - 90 percent broad-leaved, 31 percent grasses. Crabgrass (Digitaria sanguinalis) and pigweed (Amaranthus retroflexus) were the major weeds present. 2,4-D caused severe formative effects, from which the plants did not fully recover. The plants were spindly with small improperly developed leaves. PCP caused no apparent phytotoxic effects. Because of weather and drainage problems, yield data was not reliable, but it indicated that yields were reduced considerably by 2,4-D. (Contrib. of Dept. of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1282.)

Response of three varieties of potatoes to various systemic herbicides applied as pre-emergence treatments. Pavlychenko, T. K. Plots of Warba, Columbia Russett, and Bliss Triumph potatoes were treated 2 to 3 days prior to emergence with 1 and 2 pounds per acre of esters of 2,4-D (Weedone Concentrate 43 and ACP649); mixture of esters of 2,4-D and 2,4,5-T (ACP926); acetanilide of 2,4-D (ACP 646A) and acid of 2,4-D (ACP472). The volunteer weed population, consisting mainly of stinkweed (Thlaspe arvense), with some lambs' quarters (Chenopodium album) and wild buckwheat (Polygonum convolvulus), was very dense and was allowed to grow in the plots until the first week of July. Then all plots were kept free of weeds. RESULTS: The general trend in all three varieties and with most treatments was to considerably exceed the yield of the check plots. Warba series gave an average increase of 40.3 percent after decreases in the plots treated with ACP646A and ACP649 were deducted. The corresponding increases in the Columbia Russett and Bliss Triumph series were 33.6 and 34.9 percent respectively. ACP649 was damaging the yield of all three varieties both at 1 and 2 pounds per acre rates. There was a direct correlation between the degree of weed control and the volume of yield. In this project, of the 5 chemicals used, 4 have controlled the weeds to the extent that at least one cultivation was eliminated. At the same time they significantly increased crop yield. (Contrib. of Agricultural Division, American Chemical Paint Co., Saskatoon, Sask.)

Pre-emergence weed control in sweet corn with CMU. Sexsmith, J. J. CMU (3-p-chloro-phenyl-1, 1-dimethylures) was applied as a pre-emergence treatment to sweet corn five days after seeding at rates of 1 and 2 pounds per acre. Excellent weed suppression resulted from both treatments for a period of one month. Three months after treatment there were few weeds present on areas treated at the 1 pound rate, the control estimated at 85 to 90 percent. At this same time the 2 pound rate had given an excellent control of weeds estimated at 98 percent. Cool, wet weather gave poor growth conditions for corn, adversely affecting growth and stand, and it is doubtful if any definite conclusions can be reached regarding the effects of CMU on corn growth. However, it appeared that the 1 pound rate had affected the corn but little, whereas the 2 pound rate caused some slight stunting and may have caused a certain degree of stand reduction. (Contrib. of Dominion Experimental Station, Lethbridge, Alberta.)

Project IV. Control of weeds in vegetable crops, potatoes, sugar beets, small fruits, and ornamentals.

Vegetable Crops — G. F. Warren

Summary

Due to the large number of crops and herbicides involved, only those treatments which showed promise in one or more experiments will be discussed in this summary.

Onions: In pre-emergence experiments on muck soils, good control of weeds without injury to onions was obtained with CMU at ½ to 1 lb. per acre and with Stoddard solvent. Endothal gave good weed control but in one of two experiments it caused severe onion injury. 2,4-D at 1 lb. per acre gave good results in one experiment but in three others it resulted in some injury to the onions. Chloro IPC and sodium trichlorophenate showed promise in single reports. Post-emergence treatments with potassium cyanate gave consistently good results if used at sufficiently high rates and CMU and Chloro IPC also appeared promising. When the herbicidal sprays were directed so that only the base of fairly large onions was contacted, several materials gave good weed control without causing injury to the onions. This method of application is encouraging for the control of late germinating weeds.

Beans: Pre-emergence treatments with PCP at rates of 10 to 24 lbs. and DNOSBP at rates of 2 to 10 lbs. per acre gave fair to excellent weed control and little or no injury to beans. Chloro IPC, N-1 naphthyl phthalamic acid, 2,4-D and MCP also gave good results in one or more experiments. Weed control was good with 1 lb. of CMU and the beans were not injured but in other experiments 2 and 3 lbs. almost eliminated the beans. DNOSBP and 2,4-dichlorophenoxyethyl sulfate applied as the beans were emerging caused severe injury.

Peas: In pre-emergence experiments, MCP, PCP, DNOSBP, IPC and endothal all showed promise when used at appropriate rates of application. Post-emergence sprays with potassium cyanate, DNOC, DNOSBP, MCP, and MH gave good results.

Beets: Pre-emergence applications of endothal, TCA, and CMU gave good weed control. On muck soil none of these chemicals injured the beets but on a silt loam TCA caused some reduction in yield, and CMU caused severe injury even ½ lb. per acre. Post-emergence sprays with 8 lbs. of TCA applied two weeks after emergence were effective in controlling annual grasses without reducing the yield of beets.

Vine Crops: Pre-emergence treatments with 4 lbs. of N-1 naphthyl phthalamic acid resulted in good control of weeds and no injury to cucumbers, muskmelons, and watermelons. DNOSBP at 4 lbs. also gave good weed control but caused some reduction in early growth, especially of cucumbers. Post-emergence sprays of N-1 naphthyl phthalimide effectively controlled germinating crabgrass without causing injury to transplanted muskmelons.

Other Crops: Some of the promising pre-emergence treatments on other crops were as follows: spinach, TCA; carrots, IPC: asparagus, CMU; peppermint, PCP; direct-seeded tomatoes, TCA and Stoddard solvent; sweet potatoes, N-1 naphthyl phthalimide and 2,4-dichlorophenoxyethyl sulfate.

Pre-emergence spray treatments on onions. Anderson, E. T. and Shadbolt, C. A. Pre-emergence application of the isopropyl ester of 2,4-D at 1, 1½, and 2 pounds of acid per acre, and monosodium cyanamide at 25, 50, and 100 pounds per acre were made 2 days before emergence. At all rates of 2,4-D, distortions and a yellowing at the ground level were noted on the onions very shortly after emergence. The onions outgrew this,and were apparently normal, except for a retardation of the root system at the higher rates for the first two months of the growing season. Broad-leaf weeds, with red-root pigweed (Amaranthus retroflexus) and wild mustard (Brassica arvensis) predominating were controlled nearly 100% during the first part of the season. The later germinating green foxtail (Setaria virdis) was not killed by the 2,4-D treatments but was stunted throughout the season. Monosodium cyanamide at 25 pounds gave no control of any weeds. About 50% control of the broad-leaf weeds was obtained with the 50 pound, and nearly a complete control was obtained with the 100 pound treatment. There was a slight temporary burning of the seedling onions as they were emerging, at the two higher rates. The 100 pound treatment caused a very marked caking of the soil, quite evident following the first rain after treatment. (Division of Plant Science, The University of Manitoba, Winnipeg.)

The use of potassium cyanate as an herbicide in onions grown for sets. Anderson, E. T. and Shadbolt, C. A. Experiments were carried out, using 8, 16, 24, and 32 pounds of potassium cyanate per acre on Ebeneezer onions grown for the production of sets. The onions were in the flag stage, and from 1½ to 2 inches high at the time of application. Wild mustard (Brassica arvensis), which was sown with the onions, was in the 4 to 6 leaf stage when the spray was applied. Other weeds, which included stinkweed (Thlaspi arvense), lamb's quarters (Chenopodium album), wild buckwheat (Polygonum convolvulus), and red-root pigweed (Amaranthus retroflexus) were in various stages of growth from small seedling to the 8 to 10 leaf stages. Eight pounds of potassium cyanate burned the smaller weeds, but caused no killing; at 16 pounds, there was killing in only the small seedling stages of stinkweed, wild buckwheat, wild mustard, and red-root pigweed, with a severe burning of the larger weeds. At 32 pounds there was a complete kill of these 4 weed species up to and including the 4-leaf stage. There was no control of lamb's quarters at any of the rates. Weed counts indicated that at 32 pounds per acre, the total weed stand was reduced by 81%; at 24 pounds, 72%; at 16 pounds, 50%; with no reduction at 8 pounds per acre. Mustard stand was reduced 90% at 32 pounds, 75% at 24 pounds, 70% at 16 pounds, and 13% at 8 pounds. (Division of Plant Science, The University of Manitoba, Winnipeg.)

Pre-emergence treatments with MCP for control of weeds in canning peas. Anderson, E. T. and L'Arrivee, J. C. M. Two varieties of peas, Pacemaker and Early Perfection were sown on May 10, 1951. The plot size was 77 sq. ft. replicated 4 times for each variety. On May 19, 1 to 2 days before emergence of the peas, sodium MCP was applied at rates of 1, 2 and 3 lbs. (active ingredients) per acre in 50 gals. of water. At the time of application the predominant weeds were wild buckwheat (Polygonum convolvulus), green foxtail (Setaria viridis), stinkweed (Thlaspi arvense) and lamb's quarters (Chenopodium album). Excellent control of stinkweed, wild mustard and pigweed was obtained at all rates. Lamb's quarters and wild buckwheat displayed some resistance. The latter recovered from the 1 lb. treatment. Green foxtail and other grass weeds present were not affected at any of the rates. On July 12th and 18th the peas were harvested, shelled and weighed. The weeds were pulled and plot yields weighed separately. Results indicate that pea yields were not affected by the different treatments. However, the following average yields for weeds per plot were obtained: no treatment, 7.3 lbs.; 1 lb. treatment, 1.8 lbs.; 2 lbs. treatments, 0.9 lbs.; and 3 lbs. treatment, 0.9 lbs. The three treatments were significantly lower in weed yields than the "no

treatment" check. (Division of Plant Science, The University of Manitoba, Winnipeg.)

Screening tests for pre-emergence weed control in peas. Andersen, E. T. and L'Arrivee, J. C. M. The following results are from plots treated with different herbicides 1 to 2 days before emergence of the peas. The predominant weeds at the time of application were: wild buckwheat (Polygonus convolvulus), green foxtail (Setaria viridis), stinkweed (Thlaspi arvense) and lamb's quarters (Chenopodium album). The sodium salt of PCP at 20, 40 and 60 lbs. per acre gave 40, 60 and 75% control of weeds respectively. The 20 lb. rate did not affect the wild buckwheat. The residual effects of the 60 lb. treatment caused light injury to the peas which later appeared to recover fully. Endothal (EC 3740) at 2, 4 and 6 lbs. per acre gave good control of weeds present at the time of application. DNOSBP (Dow Premerge) at 3, 6 and 9 quarts per acre gave very good control of weeds with some evidence of residual effects. IPC at 5 lbs. gave poor control but the 10 and 15 lb. rates gave good control of weeds and seemed to have some residual action. The pea stand was not seriously affected. Calcium cyanamide dust was applied at 100, 200, and 300 lbs. per acre. The highest rate, only, produced some injury on wild mustard and stinkweed. No other effects were noted and no fertilizer benefits were detected. Prevalent winds made the application of the dust rather difficult. (Division of Plant Science, University of Manitoba, Winnipeg.)

Post-emergence chemical weed control in canning peas. Andersen, E. T. and L'Arrivee, J. C. M. Sodium DNOC, potassium cyanate, and soluble monosodium cyanamide were used on 2 varieties of peas, Pacemaker and Early Perfection sown May 10 at a 6 in. drill spacing. The plot size was 77 sq. ft. with 4 replications for each variety. On June 10 when the peas were 6 and 7 in. tall the chemicals at the following rates were applied: DNOC, 0, 1½, 2½ and 3½ quarts per acre in 80 gals. of water. (Ammonium sulphate was used as an activator); Potassium cyanate, 0, 8, 16 and 24 lbs. per acre in 50 gals. of water and monosodium cyanamide at 0, 16, 32, and 48 lbs. per acre in 50 gals. of water. At the time of application the predominant weeds were: red root pigweed (Amaranthus retroflexus), wild buckwheat (Polygonum convolvulus), green foxtail (Setaria viridis), stinkweed (Thlaspi arvense) and lamb's quarters (Chenopodium album). On July 12 and July 18 Pacemaker and Early Perfection varieties were harvested respectively. All the weeds in each plot were pulled and weighed at the same time. Results indicate that DNOC at 3½ quarts and potassium cyanate at 24 lbs. caused some injury to the peas and gave slight reductions in pea yields. The other rates of these two chemicals did not significantly reduce the pea yields. Soluble monosodium cyanamide caused obvious yellowing of the peas and the yields decreased as the rates of the chemical increased. Striking reductions in broad-leaf weeds was evident for all rates of all three chemicals. The variety Pacemaker appeared slightly more susceptible to high DNOC and monosodium cyanamide rates than Early Perfection. (Division of Plant Science, University of Manitoba, Winnipeg.)

Screening tests for post-emergence weed control in peas. Anderson, E. T. and L'Arrivee, J. C. M. The following results are from plots treated with different herbicides when the peas were about 6" high. The predominant weeds at the time of application were: red root pigweed (Amaranthus retroflexus), wild buckwheat (Polygonum convolvulus), green foxtail (Setaria viridis), stinkweed (Thlaspi arvense), and cultivated oats. Maleic hydrazide at 3, 6 and 9 lbs. (active ingredients) per acre gave good control of weeds by stunting and rendering them sterile. This was particularly evident for the highest rate used. The pea yields were reduced by the highest rate of treatment only. DNOSBP (Dow General) at

2, 4 and 6 pts. per acre gave 20, 40 and 65% control of broad-leaf weeds. Grass weeds did not seem to be affected. The pea yields were not significantly affected. Xanthogen disulphide at 10, 20 and 30 lbs. per acre resulted in poor control of weeds and destroyed most of the peas. Sodium MCP at 0.25, 0.5, and 0.75 lb. per acre gave poor, fair, and good control of weeds respectively. The highest rate caused some stem deformities, but did not affect the pea yields. EH 5722 at 4, 8 and 12 lbs. per acre gave poor weed control. The peas showed increased yellowing as the rate was increased and the yields were correspondingly lower. (Division of Plant Science, University of Manitoba, Winnipeg.)

The use of several herbicides for the control of weedy grasses and herbaceous weeds in hybrid yellow globe onion seedlings. Bohmont, D. W., Klingman, D. L., and Yagyu, P. K. Replicated onion seedling plots were treated with the following materials and rates per acre: Shale oil naphtha and shale kerosene 20 to 80 gal., Stoddard solvent 80 to 120 gal., E. S. 2,4-D 2-4 lbs., TCA 5-10 lbs., Chloro IPC 1-3 lbs. and CMU 1-2 lbs. All treatments were made on April 12, 1951, at Lincoln, Nebraska, when the seedlings were 1-2 inches tall. Percent control estimates were made 7 days after treatment and stand counts made of the weedy grasses, herbaceous weeds and onion stand 21 days after treatment and yields taken 95 days later. No treatment gave complete control with no injury to the onions. The best treatments were as follows: 7 days after the treatment the 60 gal. shale kerosene controlled 80% of the weeds, which was comparable to the 100 gal. Stoddard solvent. The best oil treatment determined by final stand counts was the 80 gal. naphtha which controlled 43% grasses and 79% herbaceous weeds. This was equal to the 100 gal. Stoddard solvent, however both reduced the onion stand significantly. Of the other chemicals, TCA was the most effective in controlling weeds, the 10 lb. treatment virtually controlled 100%; however, the onion stand was reduced by 58% and the final yield by 88%. The 2 lb. CMU treatment controlled 71% of the grasses, 62% of the herbaceous weeds; however, it reduced the final yield by 1/3. Chloro IPC at 3 lbs. was the best over-all treatment and controlled 75% of the weedy grasses as well as herbaceous weeds and reduced the final yield by only 8% which was not statistically significant. (Wyoming Agricultural Experiment Station, Laramie, Wyoming, Weeds Division, B.P.I.S.&A.E., Lincoln, Nebraska; and Nebraska Agricultural Experiment Station, Lincoln, Nebraska.)

Effects of TCA and CMU on asparagus. Grigsby, Buford H. Patches of quack grass in asparagus were treated in June with 40 lbs. sodium TCA. The grass was killed and no living buds were found on the rhizomes in early October. The asparagus continued to produce spears throughout the remainder of the cutting season. Vegetative growth, in early summer, appeared normal but by the end of August the young branches were twisted and deformed. The affected plants turned yellow and dried up before frost stopped the growth of untreated plants. CMU, at the rate of 10 lbs. had no visible effects on asparagus and did not control quack grass. (Michigan Agricultural Experiment Station and Weed Investigation Div. B.P.I.S.&A.E.)

The effects of CMU on weed and crop plant emergence. Grigsby, Buford H. One pound of CMU per acre, applied as a pre-emergence spray, did not affect the emergence of potatoes, gladiolus and asparagus and growth of the crops was normal throughout the season. Broad-leaved weed emergence was reduced 80%, grasses 96%. Where no cultivation was given, there were no weeds for the balance of the season. Cauliflower, broccoli and tomatoes transplanted into treated plots showed no ill effects from CMU. Pre-emergence applications on sugar beets, at rates of $\frac{1}{4}$, $\frac{1}{2}$, and 1 lb. per acre, reduced beet stands 55, 77 and 97% respectively. Weed emergence was reduced 90% or more. Onions, corn and beans, treated at the same rates, showed no effect from the chemical and similar weed reductions were found. Small amounts of

CMU appear to be effective for weed control in crops which are propagated by vegetative methods and for large seeded crops that are direct-seeded. Other crop seedlings are sensitive to less than 1 lb. of this chemical. (Michigan Agricultural Experiment Station & Weed Investigation Division B.P.I.S.&A.E.)

Pre-emergence weed control in carrots. Holm, L. G. Red-cored Chantenay carrots were planted on May 25 on an organic soil in a four replication randomized test. All of the chemicals used in the test were applied on May 29. Rainfall amounting to 1.31 inches fell during the 72 hours following treatment. Pigweed (Amaranthus retroflexus), smartweed (Polygonus hydropiper), and barnyard grass (Echinochloa crus-gali) were the predominant weeds in the area. Stand counts of both carrots and weeds were made on June 22, and the plots were maintained free from weeds thereafter. The carrots were harvested on August 24. The following chemicals were applied (all concentrations are in pounds per acre of acid equivalent or active ingredient of the appropriate compound): TCA (sodium salt) 8, 12, 16, and 20 pounds; PCP (sodium salt) 3 and 6 pounds; TCA 8 pounds mixed with 2 and 4 pounds of PCP; TCA 10 pounds mixed with 2 and 4 pounds of PCP; Niagarathal (disodium 3, 6, endoxohexahydrophthalate) 6 pounds; and CMU (3-p-chlorophenyl-1-1 dimethylurea) $\frac{1}{2}$ and 3 pounds. All of the treatments reduced the weed stands by 55% or more. The TCA when used alone reduced weed stands 55 - 65%, the TCA and PCP combinations 70 - 80%, while CMU, 3 pounds gave 93% control. All of the treatments thinned the stands of carrots to some degree while TCA, 10 pounds with PCP, 4 pounds, and TCA, 8 pounds with PCP, 2 pounds did not reduce yields significantly. TCA, 10 pounds with PCP, 2 pounds, and TCA, 8 pounds with PCP, 4 pounds, bordered on the point of significant reduction; lowering yields by about 5%. The TCA treatments reduced yields by about 18%. CMU, 3 pounds, gave a 25% reduction in yield while CMU, $\frac{1}{2}$ pound, reduced the yield 5%. A concentration of CMU midway between the latter two appears to hold considerable promise for pre-emergence work in carrots. Niagarathal caused very severe injury to the carrots. (Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wisconsin.)

Weed control in spinach. Holm, L. G. Nobel spinach was planted in a 4 replication randomized block test on May 16 in a dry silt loam soil. All chemicals were applied on May 19 and .25 inches of rain fell in the ensuing 72 hours. Weed and stand counts were taken on June 26 and the crop was harvested on the same date. The predominant weeds in the area were pigweed (Amaranthus retroflexus), lamb's quarters (Chenopodium album), barnyard grass (Echinochloa crus-gali), and quack grass (Agropyron repens). The chemicals were applied at 30 lbs. pressure in 40 gals. of water per acre on May 19 (all concentrations refer to acid equivalent or active ingredient per acre): TCA (sodium salt) 10 and 15 lbs., TCA 8 mixed with PCP (sodium salt) 2 lbs., TCA 12 with PCP 2 lbs., CMU (3-p-chlorophenyl-1-1 dimethylurea) 1 and 3 lbs., and CIPC (isopropyl-n-(3-chlorophenyl) carbamate) 10 and 15 lbs. Stands of spinach were severely reduced by CIPC 10 & 15 and CMU 3 lbs.; less severely by CMU 1 lb. Both concentrations of CIPC and also CMU 3 lbs. reduced the yields to a considerable extent. CMU 1 lb. reduced yields by 5%, while the remaining chemicals were without effect on yield. All treatments provided 95% control of grasses with the exception that both CMU concentrations provided 80% control. Control of broad-leaved weeds was very poor except in the case of CMU (both concentrations) where 80% reduction was again obtained. In a similar experiment on a muck soil in the same area CIPC 15 lbs. and the combination treatments of TCA with PCP provided only 62% control in a predominantly broad-leaved population. CIPC 10 lbs., CMU 3 lbs., and the TCA treatments were less effective; providing only 54% control. In contrast, however, to the yield data on upland soil, in this experiment only CIPC 19 lbs. seriously interfered with the yield of spinach. (Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wisconsin.)

The effect of pre-emergence herbicides on snap beans. Holm, L. G. Tendergreen snap beans were planted on a moist Miami silt loam in a three replication randomized block test on June 11. All of the chemicals were applied on June 16 and no rain fell during the 72 hours following treatment. The plots were maintained free from weeds at all times. The beans were harvested on August 7 and August 16. The following chemicals were applied in 40 gals. of water per acre before the crop emerged (all concentrations are in pounds per acre of acid equivalent or active ingredient): CMU (3-p-chlorophenyl-1-1 dimethylurea) 3 lbs.; PCP (sodium salt) 10, 15 and 20 lbs.; Niagarathal (disodium 3, 6, endoxohexahydrophthalate) 4 and 8 lbs.; and EH_1 (2,4-dichlorophenoxyethyl sulfate) 6 lbs. Stands of beans were not reduced by any of the treatments except CMU. This treatment resulted in a loss of 80% of the stand. The yield of beans was reduced significantly only by CMU 3 lbs.; Niagarathal 4 and 8 lbs. and EH_1 6 lbs. These treatments reduced yields by 30% or more. In an identical experiment conducted concurrently in an adjacent area, the following chemicals were applied at 1 and 2 lbs. per acre before the crop emerged: 2,4-D (sodium salt): 2,4-D (butoxy ethanol ester); 2,4,5-T (triethylamine); and MCP (diethanolamine). Except for a slight reduction brought about by 2,4,5-T 2 lbs., all stands of beans were equal to that of the control. This treatment also reduced the yield of beans significantly at 2 lbs. All other treatments provided yields equal to or better than the control. (Department of Horticulture, University of Wisconsin, Madison, Wisconsin.)

Effects of experimental herbicide 2 applied as a post emergence application to cabbage and cucumbers. Howat, M. G. Post-emergence sprays of E.H. 2-73 at 4, 8 and 16 lbs. per acre were applied to cabbage 31 days after transplanting, then beginning to form heads, and to cucumbers 40 days after emergence. The nozzle of the knapsack sprayer was directed to make almost a complete coverage of the ground and yet to keep the amount of herbicide applied to the leaf surface at a minimum. In cabbage no difference was observed between treatments. In cucumbers with each increase in rate of E.H. 2 there was a slight decrease in yield. When the fruit was sampled it was found that the 8 and 16 lb. treatments caused an unnatural yellowing of the skin beginning at the stem end, brittle flesh inside, and a distinctly unpleasant flavor. Only a slightly unpleasant flavor was found in the 4 lb. treatment as compared to the check. (Dominion Experimental Station, Scott, Sask.)

Post-emergence use of DNOSBP on peas. Howat, M. G. Applications of DNOSBP at the rates of 2, 3 and 5 gals. per acre was made to Little Marvel peas 28 days after emergence. The nozzle was directed to make almost a complete coverage of the ground and yet to keep a minimum amount of spray from contacting the foliage. DNOSBP at 5 gals. caused some injury to the lower foliage of peas. At 2 & 3 gals. this injury was less. Young Amaranthus retroflexus was killed by the 2 gal. treatment. As a result of all treatments made in the manner described, the yield, appearance and taste of the peas were equal to the check. (Dominion Experimental Station, Scott, Sask.)

Effects of varsol as a post-emergence treatment in carrots. Howat, M. G. Post-emergence sprays of varsol at 10, 30, 80 and 100 gals. per acre were applied to Danvers Half Long carrots 21 days after emergence. The carrots were in the 4 to 6 true leaf stage. The nozzle of the knapsack sprayer was directed to make a complete coverage of the ground and yet to keep the amount of spray applied to the leaf surface at a minimum. On July 25 parts of the leaves of plants receiving the 100 gal. treatment were yellowing. At the end of the season it was noted that the 80 and 100 gal. treatments caused the formation of leaves lighter in color and narrower in width. Otherwise the growth, stand, yield and marketable appearance

of all treatments were equal to the check. No taint in the boiled carrots were observed. (Dominion Experimental Station, Scott, Sask.)

Post-emergence use of Aero cyanate (potassium cyanate) in onions and peas. Howat, M. G. Aero cyanate was applied as a post-emergence spray to Sweet Spanish onions 21 days after transplanting at the rates of 9, 18 and 27 lbs. per acre, and to Little Marvel peas 28 days after emergence at the rates of 15, 20 and 30 lbs. per acre. No wetting agent was used. In the onions the nozzle of the knapsack sprayer was directed to make a complete coverage of the ground and yet to keep the amountof herbicide applied to the base of the plants at a minimum. In the peas the nozzle was directed to make almost a complete coverage of the ground and yet to keep the amountof spray contacting the leaves at a minimum. Foliage injury to the lower leaves of the peas was caused by the 30 lb. treatment. Injury from other treatments was very slight. In onions slight root maggot injury masked the detection of any injury which may have been caused by aero cyanate. Young Amaranthus retroflexus was controlled by the 15 lb. treatment. Accounting for plant stand in onions the yield and marketable appearance of all treatments compared favorably with the check. No difference in the yield or quality of peas could be observed between any of the treatments. (Dominion Experimental Station, Scott, Sask.)

Post-emergence use of Sulfasan (xanthogen disulfide) on cabbage, potatoes and rutabagas. Howat, M. G. Formulated Sulfasan at 1, 2 and 4 gals. per acre was used as a post-emergence spray in Copenhagen Market cabbage 21 days after transplanting, in Warba potatoes 25 days after emergence, and in Larentian Swede turnips 31 days after emergence. The nozzle of the knapsack sprayer was directed to make almost a complete coverage of the ground and yet to keep the amount of herbicide applied to the leaf surface at a minimum. In all three vegetables the 4 gal. treatment caused foliage burn wherever the spray came in contact with leaves. This injury was on the bottom leaves and only included from 5 to 10 percent of the entire leaf surface. In turnips 2 gals. caused almost equal injury. Spray at 1 gal. per acre caused less injury to turnips and very little to cabbage and potatoes. Amaranthus retroflexus 3 inches in height were controlled by the 1 gal. treatment. In cabbage, potatoes and turnips, all treatments were equal to the check in yield and marketable appearance. (Dominion Experimental Station, Scott, Sask.)

Post-emergence use of maleic hydrazide on peas and beets. Howat, M. G. A post-emergence application of 30 percent maleic hydrazide at the rates of $\frac{1}{2}$, 1 and 2 gals. per acre was applied to Detroit Dark Red beets and Stratagem peas 28 days after emergence. The nozzle of the knapsack was directed to make a complete coverage of the ground in beets and almost a complete coverage of the ground in peas, and at the same time effort was made to keep the amount of herbicide coming in contact with the plants of both beets and peas at a minimum. Growing conditions were good. As a result of the treatments made in this way the yield and appearance of both the beets and peas compared favorably to the check. (Dominion Experimental Station, Scott, Sask.)

The effects of a post-emergence treatment of maleic hydrazide, Sulfasan and varsol on sweet corn. Howat, M. G. One post-emergence application of 30 percent maleic hydrazide was sprayed as a water soluble solution at the rates of $\frac{1}{2}$, 1 and 2 gals. per acre on July 23 to Dorinny corn. To other plots Sulfasan at the rates of 1, 2 and 4 gals. per acre and varsol at the rates of 10, 50 and 80 gals. per acre were applied on July 13 as a post-emergence treatment. The corn was planted May 30. The nozzle of the knapsack sprayer was directed to make a

complete coverage of the ground and yet to keep the amount of herbicide applied to the plant stems at a minimum. Sulfasan at each rate killed most weeds present such as Amaranthus retroflexus. At the 2 and 4 gal. rates Sulfasan caused foliage injury to the lower corn leaves. All plots treated with maleic hydrazide and Sulfasan were equal to their check plots in earliness, yield and quality. Varsol at 50 and 80 gals. caused fatal injury at the base of the plant stems. The 10 gal. rate caused slight injury to the plant base and tip leaf burn. The quality of cobs produced by the plants in this plot and those which escaped direct contact to varsol in fatal amount in the other plots compared favorably with the check. (Dominion Experimental Station, Scott, Sask.)

Pre-emergence sprays on direct-seeded tomatoes. Lana, E. P. Pre-emergence sprays of Stanisol 60 gals., TCA 90% 4 and 8 lbs., 2,4-D Na salt 1 lb., acetanalide, Dow General 3 pints and 24 pints oil per 100 gals. water, PCP, sodium salt 2½ and 5 lbs. were applied 7 days before general emergence. General temperatures for the period from planting until after emergence averaged 10° below normal with excessive rainfall conditions. Weed control for all materials was poor with Dow General giving the best control reducing weed population 53% based on total weed count of the control plots (4 reps.). Plant stand was not affected except in the Dow General plots where the decrease amounted to 91%. There was no significant decrease in yield based on plots thinned to five plants. (Iowa Agricultural Experiment Station, Ames, Iowa.)

Pre-emergence sprays on snap-beans. Lana, E. P. Pre-emergence sprays of PCP sodium salt 10 and 15 lbs., Premerge 2 and 4 lbs., 2,4-D amine 1 lb. and acetanalide/ester mixture 1 lb. were applied within 24 hours after seeding. Crag Herbicide #1 at one pound per acre was applied at emergence, 4 replications of 20 plants each were used. Total weed reductions in percent were 44, 53, 53, 63, 68, 71 and 73 for the materials listed in the above order. Typical 2,4-D reactions were observed on the amine, acetanalide/ester and Crag plots. This reaction did not affect the plant above the first pair of true leaves. Crag Herbicide further permanently stunted the plants. There were no significant decreases in yield of the treated plots. (Iowa Agricultural Experiment Station, Ames, Iowa.)

Chemical weed control in green beans. Meador, D. B. and Hemphill, D. D. Four replicated randomized plots of green beans, variety Top Crop, were treated with each of the following herbicides. Sulfasan (ethyl xanthogen disulfide) 10 lbs. per acre and Premerge (dinitro-O-sec-butyl phenol, triethanolamine salt) 4 lbs. per acre were applied two days after planting, and Premerge 4 lbs. per acre was applied as the beans were emerging. Weed control four weeks after pre-emergence treatment was: (1) Premerge (pre-emergence) - 34% broad-leaved, 18% grasses. (2) Premerge (as emerging) - 82% broad-leaved, 80% grasses. (3) Sulfasan 18% broad-leaved, 0% grasses. Major weeds present were crabgrass (Digitaria sanguinalis) foxtails (Setaria sps.) ragweed (Ambrosia artemisiaefolia) and pigweed (Amaranthus retroflexus). Some damage to the crop resulted from Premerge, as evidenced by leaf burn and reduced stand. Average yields of plots were: Sulfasan 2.9 pounds, Premerge (pre-emergence) 2.9 pounds, Premerge (as emerging) 1.4 pounds, Checks 3.6 pounds. Though Premerge applied as the beans were emerging gave the best weed control the yield was reduced considerably apparently as a result of its toxicity. (Department of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1279.)

Selective weed control in sweet potatoes. Meador, D. B. and Hemphill, D. D. EH#1 (2,4-dichlorophenoxy ethyl sulfate) 4 and 6 pounds per acre and naphthyl phthalamic acid 4 lbs. per acre were applied to 5 replicated randomized plots of Ranger variety sweet potatoes two weeks after setting. The field was plowed and hoed three days before treatment. No further hand or mechanical cultivation was done. EH#1 caused formative effects which the plants eventually overcame. Naphthyl phthalamic acid caused severe formative effects which were apparent until harvest. Weed control four weeks after treatment was as follows: (1) EH#1 4 lbs. - 80.0% broad-leaved, 70.7 grasses; 6 lbs. - 77.3% broad-leaved, 71.7% grasses. (2) Naphthyl phthalamic acid 4 lbs. - 78.6% broad-leaves, 47.3% grasses. Ranger, a vigorous variety, was able to keep down further weed growth and plots were practically free of weeds at harvest. Even though control plots contained considerable crabgrass (Digitaria sanguinalis) and foxtails (Setaria sps.) their yield was about equal to that of treated plots. Average yields in pounds per plot were: control 19.1, EH#1 4 lbs. 19.5, 6 lbs. 19.4, naphthyl phthalamic 17.9. With varieties less able to compete with weeds a selective spray of EH#1 might possibly increase yields. (Department of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1285.)

Pre-emergence weed control in cucumbers. Meador, D. B. and Hemphill, D. D. Sulfasan (ethyl xanthogen disulfide) 8 lbs. per acre, Premerge (dinitro-O-sec-butyl phenol, triethanolamine salt) 4 lbs. per acre and naphthyl phthalamic acid 4 lbs. per acre each were applied to four replicated randomized plots of cucumbers, 8 days after planting. Weed control four weeks after treatment was: (1) Sulfasan - 62.6% broad-leaved, 16.4% grasses. (2) Premerge - 93.4% broad-leaved, 38.5% grasses. (3) naphthyl phthalamic acid - 64.8% broad-leaved, 28.2% grasses. Major weeds present were crabgrass (Digitaria sanquinalis) and pigweed (Amaranthus retroflexus). Premerge caused a noticeable reduction in early growth. There was no apparent toxicity from Sulfasan or naphthyl phthalamic acid. Because of almost daily rainfall, it was two months after planting before the plots could be cultivated and hoed. Check and Sulfasan plots were a solid mat of grass and broad-leaved weeds at the end of this period. Considerable young weeds were present in the Premerge and naphthyl phthalamic acid plots but these plants had not been seriously damaged by competition from weeds because of a lack of hoeing and cultivation. Average yields of plots were: naphthyl phthalamic acid - 65 pounds, Premerge - 42 pounds, Sulfasan 39 pounds, Checks - 39 pounds. Although Premerge gave better weed control than naphthyl phthalamic acid, its phytotoxicity may have caused a reduction in yield. (Department of Horticulture, Missouri Agriculture Experiment Station, Journal Series No. 1284.)

Pre-emergence weed control in cantaloupes. Meador, D. B. and Hemphill, D. D. Sulfasan (ethyl xanthogen disulfide) 8 lbs. per acre, Premerge (dinitro-O-sec-butyl phenol, triethanolamine salt) 4 lbs. per acre and naphthyl phthalamic acid 4 lbs. per acre each were applied to four replicated, randomized plots of cantaloupes 3 days after planting. Weed control four weeks after treatment was: (1) Premerge 98.4% broad-leaved, 60.8% grasses. (2) naphthyl phthalamic acid 80.1% broad-leaves, 47.3% grasses. (3) Sulfasan 41.5% broad-leaved, 8.2% grasses. Major weeds present were crabgrass (Digitaria sanguinalis), pigweed (Amaranthus retroflexus) and foxtails (Setaria sps.). Premerge caused a small reduction in early growth as determined by plant measurements. There was no apparent toxicity from Sulfasan or naphthyl phthalamic acid. Because of the almost daily rainfall, it was two months after planting before the plants could be cultivated or hoed. Check and Sulfasan plots were completely covered with grass and broad-leaved weeds at the end of this period and the cantaloupe plants were yellow and stunted. Considerable young weeds were present in the Premerge and naphthyl phthalamic plots, but these plants had not been seriously damaged by competition from weeds because of a lack

of hoeing and cultivation. Average yields of plots were: naphthyl phthalamine acid - 62.3 pounds, Premerge 57.8 pounds, Sulfasan 27.9 pounds, checks 24.6 pounds. (Department of Horticulture, Missouri Agriculture Experiment Station, Journal Series No. 1283.)

Pre-emergence weed control in watermelons. Meador, D. B. and Hemphill, D. D. Sulfasan (ethyl xanthogen disulfide) 8 lbs. per acre, Premerge (dinitro-O-sec-butyl phenol, triethanolamine salt) 4 lbs. per acre and naphthyl phthalamic acid 4 lbs. per acre each were applied to four replicated randomized plots of watermelons 3 days after planting. Weed control four weeks after treatment was: (1) Sulfasan - 41.7% broad-leaved, 37.3% grasses. (2) Premerge - 96.1% broad-leaved, 64.5% grasses. (3) napthyl phthalamic acid - 79.5% broad-leaved, 62.7% grasses. Major weeds present were crabgrass (Digitaria sanguinalis), pigweed (Amaranthus retroflexus) and foxtails (Setaria sps.). Premerge caused a reduction in early growth as determined by plant measurements. There was no apparent toxicity from Sulfasan or naphthyl phthalamic acid. Because of almost daily rainfall, it was two months after planting before the plots could be cultivated and hoed. Check plots were completely covered with grass and broad-leaved weeds at the end of this time, and the Sulfasan plots were almost as bad. Considerable young weeds were present in the Premerge and naphthyl phthalamic acid plots, but these plants had not been seriously damaged by competition from weeds because of a lack of hoeing and cultivation. Average yields of plots were: naphthyl phthalamic acid - 122.2 pounds, Premerge - 114 pounds, Sulfasan 109.5 pounds, checks - 82.7 pounds. (Department of Horticulture, Missouri Agricultural Experiment Station, Journal Series No. 1281.)

Influence of depth of seeding and time and rate of application on the effectiveness of 2,4-D and MCP as pre-emergence herbicides for onions. Nylund, R. E. Brigham Yellow Globe onions were seeded on muck soil on May 3, 1951 in five blocks. One-half of each block was seeded at $\frac{1}{2}$" depth and the other one-half at 1" depth. Within each of the depth of planting plots the following treatments were applied to single-row randomized plots in a factorial design: (1) two herbicides: 2,4-D amine (alkanolamine salt) and MCP salt (amine); (2) three rates of each herbicide: 0, $\frac{1}{2}$ and 1 lb. acid per acre; (3) two dates of application of each herbicide: 8 days and 10 days after seeding. A few onions had emerged by 10 days after seeding (May 13). Weed counts were made on May 17 and again on May 29, and stands and yields of onions were recorded at harvest. Temperatures during the treatment period ranged mostly between 40° F. and 70° F. during the three days before treatment, and between 56° F. and 70° F. for the six days following the second application (May 13). Precipitation during the two week period following treatments was 3.55 inches. Stands and yields of onions were not affected by differences in depth of seeding. Likewise the reactinns of weeds and onions to the various rates and dates of application of 2,4-D and MCP were not differentially affected by depth of seeding. As an average of all herbicide treatments, weed control and yields of onions were equal in the plots sprayed 8 days and 10 days after seeding. Weed control with 2,4-D and MCP was equal with $\frac{1}{2}$ lb. per acre killing 39% and 1 lb. per acre killing 61% of the weeds present. MCP was more toxic to onions than was 2,4-D as indicated by a greater reduction in both stands and yields of onions. Yield reductions were 10% and 16% for 2,4-D at $\frac{1}{2}$ lb. and 1 lb., respectively, and 16% and 39% for MCP at $\frac{1}{2}$ lb. and 1 lb. respectively. Thus, under the conditions of this experiment the toxicity of 2,4-D and MCP to weeds and onions was not affected by varying depth of seeding or time of application. (Paper No. 2732 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.)

Pre-emergence control of weeds in onions. Nylund, R. E. On May 3, 1951 a muck soil which had been prepared on the same day, was seeded to Brigam Yellow Globe onions. On the tenth day after seeding (May 13), at which time the onion seed had germinated but had not emerged and weeds up to ¼" tall were present, the following 26 pre-emergence treatments were applied to plots replicated five times: potassium cyanate at 8, 12, 16 and 20 lbs. per acre; Stoddard solvent (B. R. 310-394° F., 18% aromatics) at 40, 60, and 80 gal.; Esso No. 45 (B. R. 325-552° F., 85% aromatics) at 20, 40, and 80 gal.; sodium trichlorophenate at 10 and 15 lbs.; sodium trichlorophenate at 10 and 15 lbs.; sodium tetrachlorophenate at 7½ and 10 lbs.; 2,4-D amine salt (alkanolamine) at ½ and 1 lb.; endothal (Niagarathal-W) at 2, 4 and 8 lbs.; chlorophenyl dimethylurea (DuPont's CMU) at ¼, ½, 1 and 2 lbs.; and sodium 2,4-dichlorophenyl sulphate (Crag Herbicide No. 1) at 2, 4, and 8 lbs. Precipitation during the two week period following treatment was 3.55 inches. The following treatments gave good weed control (55-87%) within five days after treatment without resulting in reduced yields of onions: Stoddard solvent at 40, 60, and 80 gal. per acre; Esso No. 45 at 20 gal.; and sodium trichlorophenate at 10 lb. per acre. Weed counts taken again 15 days after treatment indicated that the 1 and 2 lb. rates of p-chlorophenyl dimethylurea (CMU), had good residual properties and had killed 75% of the weeds (primarily broad-leaved weeds) without reducing stands and yields of onions. The following treatments gave fair to good weed control but also reduced yields of onions: Esso No. 45 at 40 and 80 gal. per acre, 10 lbs. sodium tetrachlorophenate, 2,4-D at 1 lb. per acre, endothal at all rates, and Crag Herbicide No. 1. (Paper No. 2735 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.)

Control of weeds in onions with post-emergence herbicide treatments. Nylund, R. E. Brigham Yellow Globe onions seeded on May 3, 1951 in muck soil were sprayed with the following nine herbicides: potassium cyanate at 16 lbs. and 20 lbs. per acre; endothal (Niagarathal-W) at 4 lbs. and 8 lbs. per acre; p-chlorophenyl dimethylurea (DuPont's CMU) at 1, 2, 3.1bs. per acre; and DNOSBP-phenol (Dow General) at 0.85 lbs. and 1.70 lbs. per acre. The above herbicides were applied to onions in the one-leaf stage (June 4) and to onions having 6-8 leaves (July 10). A shielded nozzle was used on the sprayer and the spray was directed so as to avoid hitting the tops of the onion plants. All of the herbicides used gave fair to good control of weeds when applied to onions in the one-leaf stage. However, endothal and DNOSBP both significantly reduced stands and yields of onions while potassium cyanate at both rates and CMU at 2 and 3 lbs. per acre tended to reduce yields. Weeds present during the June 4 applications were pigweed, shepherds' purse, foxtails, and a few small purslane plants. The later application (July 10) was made at the time when purslane was the principal weed present. With the exception of 16 lbs. of potassium cyanate, all of the herbicides used gave good control of weeds when applied to onions having 6-8 leaves (July 10). While none of the treatments reduced stands of onions, endothal significantly reduced yields of mature onions. All of the other herbicides tended to reduce yields of onions slightly particularly CMU at 2 and 3 lbs. and DNOSBP at 1.7 lbs. per acre. From the standpoints of weed control and lack of injury to the crop potassium cyanate at 20 lbs., CMU at 1 lb., and DNOSBP at .85 lb. were most satisfactory. (Paper No. 2731 of the Scientific Journal Series of the Minnesota Agricultural Experiment Station.)

Effect of various formulations in parsnips, carrots and beans, applied as pre-emergence treatments, 1951. Pavlychenko, T. K. Replicated plots of parsnips, carrots and beans were treated prior to emergence with 1 and 2 lbs. per acre of amine of MCP (Weedar MCP), low volatile ester of 2,4-D (Weedone LV4), acetanilide of 2,4-D (ACP646A), mixture of 2,4-D and 2,4,5-T (ACP926); 6 and 12 lbs.

of IPC; 10 and 15 lbs. of KCN and 5 and 10 lbs. of TCA. Careful notes were taken on the density of stand of annual weeds which grew in the plots before July 1st., after which date the plots were kept weed free. Notes were also taken on the stand, vigor and yield of each vegetable crop. Results: Increases in the yield of parsnips were obtained with Weedar MCP, 1 and 2 lbs.; Weedone LV4, 2 lbs.; ACP646A, 1 and 2 lbs.; ACP926, 2 lbs.; IPC, 12 lbs. and KCN, 15 lbs., ranging from 2% with KCN 15 lbs. to 73% with Weedone LV4, 2 lbs. These increases were obviously due to the good measure of weed control effected by the treatments, since an increase in the degree of weed control usually corresponded to a proportional increase in the yield of the crop. The yield of parsnips was decreased by all remaining treatments, ranging from 2% with LV4, 1 lb. to 61% with TCA, 5 lbs. Carrots appeared to be very susceptible and the yield was significantly reduced (7 to 98%) by all treatments, excepting IPC, 12 lbs. which gave a yield increase of 31%. Beans suffered extensive damage to vigor (deformed and discolored leaves) and yield with TCA, KCN and the 1 lb. rate of Weedone LV4. Yield increases occurred with IPC, ACP646A, the 2 lbs. rate of ACP926 and the 1 lb. rate of Weedar MCP, ranging from 2% with Weedar MCP, 1 lb. to 32% with ACP646A, 2 lbs. (Agr. Div., American Chemical Paint Co., Saskatoon, Sask.).

Studies on the residual effects of TCA used in herbicidal concentrations on red beets. Tibbitts, T. W. and Holm, L. G. Randomized split-plot block design experiments, ½ acre in size, were initiated in 1950 to study the effects of TCA in both organic and silt loam vegetable soils. These tests were replicated four times. Each replicate included a control which received no spray and separate TCA blocks were treated with 5, 15 and 30 lbs. of acid equivalent per acre on June 1, 1950. In that season the entire area was planted to beets. In 1951 a portion of each sprayed block was planted on June 20 to Perfected Detroit beets and Tendergreen snap beans (snap beans, because of their high sensitivity to TCA) to determine whether residual quantities of TCA from the 1950 application were present in sufficiently great amounts to injure either crop. Stand and yield data were taken from both beets and beans. The beans were harvested at two different dates in order to provide information concerning possible delay in maturity. Day by day observations of the plants as they germinated and grew to maturity did not disclose any visible symptoms of TCA injury. Statistical analysis of stand counts of beets and beans grown on both soils show no reductions at any of the concentrations of TCA. The yield results from both soil types disclosed that there were no reductions in total yield nor delay in maturity from any of the previous years treatments. Stands of German millet broadcast this year on the silt loam plots treated in 1950 were not significantly reduced at any of the concentrations of TCA. The experiments are being continued through 1953. (Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wisconsin.).

Post-emergence weed control in red beets with TCA. Tibbitts, T. W. and Holm, L. G. Detroit Dark Red beets were planted on May 15 in organic soil in a 4 replicate randomized block design experiment in order to study the effect of TCA (sodium salt) at 8, 12, and 16 pounds (acid equivalent) per acre when applied one, two, and four weeks after emergence of the beets. Applications were made with a hand sprayer using forty gallons of water per acre. The predominant weeds were pigweed (Amaranthus retroflexus), smartweed (Polygonum sp.), and barnyard grass (Echinochloa Crus-gali). Rainfall amounting to .76" fell within 24 hours following the application made one week after beet emergence. No injury to the beets was apparent. Two weeks later, however, the smartweeds and barnyard grass were noticeably stunted at rates of 12 and 16 pounds of TCA. The application of 12 and 16 pounds of TCA two weeks after beet emergence caused necrotic areas to appear on the exposed weed leaves but resulted in no injury to the beets which were shielded by a very intense weed growth. Stunting of the smartweeds was evidenced with this

treatment also. The four week treatment on all plots was ineffective in slowing growth of the very vigorous stand of weeds. An identical experiment was performed on a silt loam soil in the same area. German millet was broadcast over the area before planting beets. Complete control of millet was obtained at all concentrations and dates of application. Partial stunting of pigweed was caused by application of 12 and 16 pounds at one and two weeks. Burning of the beet leaves was noticeable with all rates at the first date of treatment with the most severe injury at 12 and 16 pounds. In summary, on areas where grasses are present and the beets emerge before sprays can be applied, an application of 8 pounds of TCA 2 weeks after beet emergence should provide effective control of these weeds. (Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wisconsin.)

Pre-emergence weed control in red beets. Tibbitts, T. W., and Holm, L. G. Beets (Detroit Dark Red) were planted on May 15 on organic soil in a four replication experiment. The chemicals were applied on May 18 in 40 gallons per acre of water. Rainfall amounting to .27" fell during the 72 hours following treatment. The predominating weeds in the area were pigweed (Amaranthus retroflexus), smartweed (Polygonum sp.), and barnyard grass (Echinochloa crus-gali). Stand counts of both weeds and beets were made on June 20. The plots were maintained free from weeds after June 25 and were harvested on August 1. The chemical treatments were as follows (all concentrations are in lbs. per acre of acid equivalent or active ingredient of the appropriate compounds); chloro IPC (emulsifiable oil) 10 and 15 lb.; disodium 3, 6 endoxohexahydrophthalate (Niagarathal) 4 and 8 lbs.; combinations of 8 lbs. of chloro IPC with 2 and 4 lbs. of Niagarathal; calcium salt of TCA, 8 and 12 lbs.; trichlorophenol (sodium salt) 4, 8, and 12 lbs.; tetrachlorophenol (sodium salt) 4, 8, and 12 lbs.; CMU (3-p-chlorophenyl-1-1 dimethylurea) $\frac{1}{2}$ and 2 lbs.; and PCP in oil 3 and 6 lbs. Three treatments: Niagarathal 4 lbs., Niagarathal 8 lbs., and CMU 2 lbs. gave very effective weed control and did not reduce the numbers of yield of harvested beets. They provide 73, 88 and 66% control of weeds respectively. These three treatments also proved outstanding in a similar experiment on silt loam soil on which German millet had been broadcast and where the predominant weeds were pigweed, lamb's quarters (Chenopodium album) and sheperd's purse (Capsella bursa-pastoris). In this case Niagarathal at 4 and 8 lbs. controlled 90% of all weeds present while CMU, 2 lbs., though it provided good weed control, caused severe injury to the beets. CMU at $\frac{1}{2}$ lb. per acre controlled 90% of the weeds but reduced beet stands by 36%. (Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wisconsin.)

Pre-emergence weed control in red beets with TCA and PCP. Tibbitts, T. W. and Holm, L. G. Detroit Dark Red beets were planted on May 15 on organic soil in a 4 replication experiment. The chemicals were applied on May 16 in 40 gallons per acre of water. Rainfall amounting to .31" fell during the 72 hours following treatment. The predominant weeds in the area were pigweed (Amaranthus retroflexus), smartweed (Polygonum sp.), and barnyard grass (Echinochloa crus-gali). Stand counts of both beets and weeds were made on June 19 and subsequent to July 6 all plots were maintained free from weeds. TCA (sodium salt) was applied at the rate of 8, 12, 16 and 20 pounds of acid equivalent per acre and PCP (sodium salt) was applied at the rate of 2, 4, 6 and 8 pounds per acre. The following combinations of TCA and PCP were included in the experiment: TCA 8 pounds mixed with 2 and 4 pounds of PCP, TCA 10 pounds mixed with 2 and 4 pounds of PCP, TCA 12 pounds mixed with 2 and 4 pounds of PCP, and TCA 16 pounds mixed with 2 and 4 pounds of PCP. All rates of TCA and all combinations of TCA and PCP reduced the weed stands significantly at the 1% level. PCP alone did not significantly reduce weed stands.

The control of weeds varied from 75% with TCA 16 + PCP 4 to 40% with TCA 8, and TCA 8 + PCP 2 pounds. The stand of beets was reduced significantly at the 1% level by the following treatments: TCA 20, PCP 8, TCA 10 + PCP 4, TCA 12 + PCP 4, TCA 16 + PCP 2, and TCA 16 + PCP 4 pounds. However, the total number and weight of harvested beets was not significantly reduced by any of the treatments. The experiment was repeated on a silt loam in the same area on which German millet had been broadcast and where the predominant weeds were pigweed, lamb's quarters (Chenopodium album), and sheperd's purse (Capsella bursa-pastoris). The results on weed control were similar with the exception that in this area 4 pounds of PCP in combination with TCA gave better control of broad-leaved weeds than 2 pounds in each combination with TCA. Also, all rates of TCA alone, TCA 8 + PCP 4, TCA 10 + PCP 4, TCA 16 + PCP 2, and TCA 16 + PCP 4 gave significant reductions in yield of beets. In some cases this amounted to as much as 30%. (Department of Horticulture, University of Wisconsin, Agricultural Experiment Station, Madison, Wisconsin.)

Pre-emergence weed control in onions. Warren, G. F., Larsen, John and Ellis, N. K. Early Yellow Globe onion seed was planted 1½ inches deep in muck soil April 24 and sprayed May 2 just before the onions emerged. Many weeds of all species present, except purslane, had emerged before spraying. The soil surface was dry, weather partly cloudy, maximum temperature 90° F. The following treatments were applied in 50 gals. of water per acre and replicated 5 times: 2,4-D (amine), 1 lb. acid equivalent per acre; endothal (with ammonium sulfate activator) 4 lbs.; N-1 naphthyl phthalamic acid, 4 lbs.; Chloro IPC, 8 lbs.; dichloral urea, 8 lbs.; and CMU, ½ lb. A wetting agent was added to all sprays except Chloro IPC which already contained emulsifiers. The only precipitation during the two weeks following treatment was 2.60 inches of rain on May 11. Weed counts were made May 25 and all weeds removed by cultivation and hand weeding throughout the remainder of the season. The onions were harvested August 28. The following treatments gave over 55% reductions in the weed species indicated: pigweed (Amaranthus retroflexus), endothal, 2,4-D and CMU; annual smartweed (Polygonum spp.), Chloro IPC, endothal, CMU and 2,4-D; purslane (Portulaca oleracea), endothal, 2,4-D, Chloro IPC and N-1 naphthyl phthalamic acid. Little or no control was obtained with any treatment on two species of annual grasses (unidentified) except that endothal killed nearly all of one species but did not effect the other. None of the treatments caused any significant effect on the stand or yield of onions except dichloral urea which significantly reduced the stand but not the yield. (Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.)

Tolerance of onions to residual herbicides applied as post-emergence sprays. Warren, G. F., Larsen, John and Ellis, N. K. Early Yellow Globe onion seed was planted in muck soil April 30. All weeds were removed throughout the season by cultivation and hand weeding. On June 15 the following treatments were applied in a Latin square design: endothal (disodium salt), 4 lbs. per acre; Chloro IPC, 8 lbs.; sodium 2,4-dichlorophenoxyethyl sulfate, 4 lbs.; CMU, 1 lb.; and control (no treatment). The treatments were applied as complete coverage sprays in water at 50 gals. per acre. Maximum temperature on June 15 was 92° F. and the sky was clear. Only .12 inches of rain fell in the previous two weeks while 1.55 inches fell in the first week and .32 inches in the second week after treatment. The onions were harvested September 5. Endothal caused severe burning of the onion tops and a highly significant reduction in yield. None of the other treatments caused any apparent damage to the onions and yields were not significantly effected. Since the three treatments that did not injure the onions are known to give residual effects in the soil, they appear promising for the control of late germinating weeds such as purslane. (Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.)

Tolerance of onions to herbicides applied as post-emergence directional sprays. Warren, G. F., Larsen, John and Ellis, N. K. Early Yellow Globe onion seed was planted in muck soil April 30. All weeds were removed throughout the season by cultivation and hand weeding. On July 20 the following treatments were applied in 50 gals. of water per acre: endothal (with ammonium sulfate activator), 2 lbs. per acre; sodium isopropyl xanthate, 16 lbs.; potassium cyanate 16 lbs.; sodium chloroacetate, 16 lbs.; CMU, 1 lb.; an aromatic oil with a boiling range of 260 to 300° F. (E.H.3) 8 gals.; DNOSBP (in an oil carrier) 1 lb. Treatments were replicated 4 times and a wetting agent was added to all sprays. Two drop nozzles were used per row and so arranged that only the basal 0 to 2 inches of the onion plants were hit by the sprays. The maximum temperature on day of treatment was 93° F. and the sky was clear. There was no precipitation during the week before treatment and .3 inches during the week following. The onions were harvested September 5. Observed injury to the onion foliage was slight to none. The yields were extremely variable and differences were not statistically significant. The lack of any appreciable injury to the onions and the fact that all of the treatments used have controlled many small weeds in other experiments, indicates promise for directional sprays in the control of late germinating weeds. (Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.)

Pre-emergence weed control in peppermint. Warren, G. F., Larsen, John and Ellis, N.K. One-year-old peppermint (meadow mint) on muck soil received the second spring disking just before the application of the following treatments: TCA (sodium salt), 8 and 16 lbs. of acid equivalent per acre; dichloral urea, 8 and 16 lbs.; Chloro IPC, 8 lbs.; DNOSBP (amine salt), 10 lbs.; PCP (sodium salt), 24 lbs.; CMU, 1 lb.; N-1 naphthyl phthalamic acid, 4 lbs.; 2,4-D (amine), 2 lbs. of acid equivalent; and sodium 2,4-dichlorophenoxyethyl sulfate, 4 lbs. Treatments were applied in water May 16 at the rate of 50 gals. per acre and replicated 4 times. Some mint was up, but no weeds were showing and the soil was moist at the time of spraying. Rainfall during the first week after treatment totaled .42 inches and during the second week 1.65 inches. Weed counts were made June 11. The following treatments gave over 75% reductions in the weed species indicated: pigweed (Amaranthus retroflexus), PCP; purslane (Portulaca oleracea), DNOSBP, Chloro IPC, 2,4-D, 2,4-dichlorophenoxyethyl sulphate, PCP and CMU; annual grasses, TCA and dichloral urea at 8 and 16 lbs. and PCP. DNOSBP caused some reduction in stand but no reduction in vigor of the mint. 2,4-D, and to a lesser extent 2,4-dichlorophenoxyethyl sulfate, caused distortion to some plants early in the season. There was no apparent injury to the mint from the other treatments. Since no hand or mechanical weeding was done after the treatments were applied in May, weed competition was severe. The controls and a few of the treatments were harvested July 20. The yield of oil was lowest on the control plots but was also extremely low on all treated plots harvested except those treated with PCP. The latter treatment gave a normal yield. Since PCP showed the best over-all weed control and caused no apparent injury to the mint, it appears especially promising. (Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.)

Crabgrass control in muskmelons. Warren, G. F. Purdue 44 muskmelons transplanted May 12 into a fine sand soil were given the following treatments immediately after cultivating on May 18: N-1 naphthyl phthalamic acid, 1, 2 and 4 lbs. per acre; N-1 naphthyl phthalimide, 2 and 4 lbs.; and dichloral urea, 4, 8 and 16 lbs. The treatments were replicated 4 times and all materials were applied in water at the rate of 50 gals. per acre. At time of spraying, the soil surface was dry and the temperature 90° F. Precipitation during the next 2 weeks totaled 1.85 inches and all occurred between May 22 and 26. Counts of crabgrass (Digitaria

sanquinalis) were made June 12 and July 9 and all plots were clean cultivated and hoed immediately after each count was made. Reduction in total crabgrass counts with N-1 naphthyl phthalamic acid and N-1 naphthyl phthalimide ranged from 45 to 75% and the remaining crabgrass was severely stunted. Control increased with rate of application. At comparable rates the "imide" and "acid" gave similar crabgrass counts on June 12 but counts for the "imide" were lower on July 9 indicating a longer residual effect. At 4 lbs. per acre the "acid" caused some stunting of the muskmelons and significantly delayed maturity but did not reduce the final yield. The "imide" and the other "acid" treatments caused no apparent injury to the muskmelons and did not delay maturity or reduce yield. Dichloral urea reduced crabgrass numbers by 15 to 55%. It produced chlorosis of the tips of the melon vines, severely stunted their growth, and resulted in an extreme delay in maturity but did not significatnly reduce the final yield. N-1 naphthyl phthalimide at 2 to 4 lbs. per acre appeared especially promising for crabgrass control in transplanted muskmelons. (Department of Horticulture, Purdue University, Agricultural Experimental Station, Lafayette, Indiana.)

Crabgrass control in sweet potatoes. Warren, G. F. Yellow Jersey sweet potatoes transplanted May 9 into a fine sand soil were given the following treatments on May 10 immediately after a .61 inch rain: N-1 naphthyl phthalamic acid, 1, 2 and 4 lbs. per acre; N-1 naphthyl phthalimide, 2 and 4 lbs.; and Chloro IPC, 4 and 8 lbs. A second set of plots received the same treatments on May 18 when the soil surface was dry. Treatments were replicated 6 times and all materials were applied in water at the rate of 50 gals. per acre. The only precipitation between May 10 and June 1 was 1.85 inches occuring between May 22 and 26. Counts of crabgrass (Digitaria sanguinalis) were made on May 31 and June 12 and all plots were cultivated and hoed immediately after each count and kept clean throughout the remainder of the season. All N-1 naphthyl phthalamic acid and N-1 naphthyl phthalimide treatments applied on May 10 gave over a 50% reduction in total crabgrass counts and severely stunted the remaining crabgrass plants but the May 18 applications were somewhat less effective. All treatments with the "acid", especially the early application, caused from slight to severe formative effects on the sweet potatoes which were gradually outgrown. The 2 and 4 lb. applications on May 10 resulted in significantly lower yields. The "imide" formulation caused no apparent injury to the sweet potatoes and did not reduce the yield. Chloro IPC at 4 lbs. reduced the total crabgrass numbers by over 50% and at 8 lbs. by over 80%. Results were similar at both dates of application. Stunting of the sweet potatoes varied from moderate to extremely severe and the yield was significantly reduced by all Chloro IPC treatments except the 4 lb. rate applied May 10. The most promising treatment in this experiment, when both crabgrass control and lack of injury to the sweet potatoes are considered, was N-1 naphthyl phthalimide applied the day after transplanting at the rate of 2 lbs. per acre. (Department of Horticulture, Agricultural Experiment Station, Lafayette, Indiana.)

Pre-emergence weed control in direct-seeded tomatoes. Warren, G. F. Rutgers tomato seed was planted 3/4 inch deep in a silt loam soil on May 4. On May 15, with clear weather, approximately two days before the tomatoes started to emerge, the following treatments were applied: sodium isopropyl xanthate, 16 lbs. per acre; sodium chloracetate, 16 lbs.; ACX 337 (an aromatic oil), 4 gal.; PCP (9.4% in oil), 2 and 4 lbs.; Stoddard solvent 50 and 100 gals.; and TCA (sodium salt), 2 and 4 lbs. of acid equivalent. In addition, the first 4 treatments were also applied in combination with 2 lbs. per acre of TCA. The treatments were replicated 5 times and all materials except Stoddard solvent were applied in water at the rate of 50 gals. per acre and a wetting agent was added. Precipitation during the 3 days before spraying totaled 1.67 inches but no rain fell in the 2 weeks after treatment. Weed and tomato plant counts were made between May 30 and June 7 and

the experiment was discontinued a few weeks later. All treatments that included TCA alone or in combination with other materials reduced the number of grasses (Setaria lutescens and Digitaria sanguinalis) by 50% or more and severely stunted the remaining grass plants. Stoddard solvent at both rates also reduced grass numbers by 50% or more but no treatments gave any appreciable control. All treatments except TCA alone reduced the counts of each of the following broad-leaved weeds by 60 to 100%: pigweed (Amaranthus retroflexus), lamb's quarters (Chenopodium album), smartweed (Polygonum spp.), and velvet leaf (Abutilor Theophrasti). TCA at the 2 and 4 lb. rates reduced pigweed numbers by 62 and 84% respectively but did not give appreciable control of the other broad-leaved species. The tomato stand was significantly reduced by 100 gals. of Stoddard solvent, 4 lbs. of PCP and by all treatments containing sodium chloracetate and sodium isopropyl xanthate. All plants that survived in all plots appeared normal. Considering both stand of tomatoes and over-all weed control in this experiment, where grasses made up approximately three-fourths of the weed population, the best treatments were as follows: 4 gal. of ACX 337 combined with 2 lbs. of TCA, 2 lbs. of PCP combined with 2 lbs. of TCA, 2 and 4 lbs. of TCA alone, and 50 gals. of Stoddard solvent. (Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.)

Pre-emergence weed control in lima beans. Warren, G. F. Early Thorogreen lima beans were planted one inch deep in a silt loam soil on July 23 a few hours after a .63 inch rain. The next day the following treatments were applied: DNOSBP (amine salt), 6 and 10 lbs. per acre; PCP (sodium salt), 16 and 24 lbs.; N-1 naphthyl phthalamic acid, 8 lbs.; Chloro IPC, 8 lbs.; and CMU, 2 lbs. The treatments were replicated 5 times and all materials were applied in water at the rate of 50 gals. per acre. Precipitation during the two weeks after spraying was 1.85 inches on July 28, and .73 inches on August 7. Reduction in grass counts, mostly crabgrass (Digitaria sanguinalis) on August 17 were as follows: CMU, 97%; Chloro IPC, 90%; DNOSBP at 10 lbs., PCP at 24 lbs., and N-1 naphthyl phthalamic acid, 60 to 70%; DNOSBP at 6 lbs. and PCP at 16 lbs., less than 40%. All treatments gave over 75% reductions in the small number of broad-leaved weeds present. CMU caused severe chlorosis of the beans and a 69% reduction in stand. Chloro IPC reduced the stand by 17%. No other treatments reduced the stand significantly and none of them except CMU caused much depression in growth or delay in blossoming. No yield records were obtained. The rate of application of CMU was probably excessive and that of Chloro IPC may also have been to high. (Department of Horticulture, Purdue University, Agricultural Experiment Station, Lafayette, Indiana.)

Project V. New Herbicides. W. C. Dutton

Summary

Eighty-one abstracts on new herbicides were received and the interest and amount of research activity is indicated by the following listing of reports received for these materials:--

CMU - 36, endothal - 24, chloro IPC - 16, MCP - 13, 2,4-dichlorophenoxyethyl sulfate - 12, N-1-naphthylphthalmic acid - 9, maleic hydrazide - 8, dichloral urea - 8, sodium trichloroacrylate - 4, N-2-chlorophenylphthalmic acid - 2, sodium trichlorophenate - 2, sodium tetrachlorophenate - 2, parachlorophenoxy-acetic acid - 1, Phthalini - 1, and hydrazine derivatives of carbonic and thio-carbonic acid - 1. The results obtained with these materials will be discussed in reverse order of the above listing.

Hydrazine derivatives of carbonic and thiocarbonic acids are new compounds, two of which have shown herbicidal activity and one appears to be selective for grasses. Phthalini as a pre-emergence treatment in sugar beets up to 8 lb./A. had no effect on beets or weeds. An ester of parachlorophenoxyacetic acid at 1½ and 2 lb/A. gave good indications on buckbrush but was not equal to 2,4-D. Sodium trichlorophenate and sodium tetrachlorophenate were used on red beets and onions. The trichlorophenate at 10 lb./A. gave good weed control in onions and no reduction in yield but was not reported as satisfactory on red beets. The tetrachlorophenate at 10 lb./A. in onions gave fair weed control but reduced stand and apparently was not satisfactory on red beets. N-2-chlorophenylphthalmic acid was not effective at 8 lb./A. on foxtail and as a pre-emergence treatment caused serious stunting of sugar beets. Sodium trichloroacrylate at 16 lb. gave 80% or better control of annual grasses in one trial and about 75% at 6 lb. in another but was not equal to TCA. Leafy spurge was not completely controlled with as much as 80 lb./A. and good results were not reported with 40 lb. on Russian knapweed. Dichloral urea was ineffective on foxtail at 8 lb.; on strawberries gave reasonable weed control but reduced runner count without, however, reducing berry yield; in a nursery gave poor weed control at 6 lb. and no effect on nursery plants and 4 lb. in a nursery transplant bed gave poor weed control and bronzed the foliage of transplants. Crabgrass in a lawn was completely controlled with 5 lb. with slight injury to bluegrass and in sugar beets 8 lb. was effective against foxtail with little damage to beets.

Maleic hydrazide in a 2% spray prevented seed pod formation on common milkweed, eliminated proliferation and root stimulation on soybeans caused by 2,4-D and was effective in checking weed and grass growth in a cherry orchard. Wild oats (8 to 10 in. high) was well controlled with 40 lb. and severely stunted with 10 and 20 lb. Foxtail (3 to 4 in. high) was controlled with 20 lb. and stunted considerably with 10 lb./A. In another trial 8 lb. gave 40% control of foxtail and was less effective than CMU and endothal. Oats, wheat, barley and flax were all killed by applying to recently emerged plants (2 to 3 in.) and it was reasoned that wild oats could be killed selectively with MH if they emerge ahead of crops. Other reports indicate severe injury from pre-emergence treatments to cereals and flax began at 40 lb. and from post-emergence treatmnets at 20 lb. In strawberries, 8 to 12 lb. was necessary for weed control and these rates reduced runner formation and fruit yield. In greenhouse studies 4 lb. in pre-emergence treatment injured sugar beets and did not kill weeds. Activity was greater when worked into soil.

N-1-naphthylphthalmic acid was not effective against foxtail at 8 lb., injured sugar beets at 2 lb. in one trial and gave fair control of grasses at 2 to 4 lb. 4 lb. caused no injury to cucumbers and increased yield and gave good weed control and high yield with muskmelons and watermelons. There was good weed control and no yield reduction of sweet potatoes. Sugar beets were seriously stunted by pre-emergence treatments and there was yield reduction of corn from 3 to 6 lb.

2,4-Dichlorophenoxy ethyl sulfate at 4 lb. gave excellent weed control in strawberries and yield increase in everbearing strawberries, 4 to 6 lb. gave good weed control in raspberries and in June bearing strawberries 2, 4 and 8 lb. applied in 1950 gave no reduction of yield or runner formation. 2, 4 and 6 lb. treatments were used in 1951 with good weed control but some runner reduction. In other strawberry work 2 and 4 lb. gave noticeable runner reduction but had little effect on yield. Four pounds were equal to 2 lb. of 2,4-D in weed control and did not reduce yield as much and in another trial 6 lb. reduced runners slightly. Nursery weeds were controlled by 4 to 6 lb. and with no injury to most nursery plants. In conifer transplant beds 4 lb. gave 97% weed control and no effect on transplants. Weeds were controlled in soybeans but serious injury resulted from effective rates and pre-emergence treatments in onions controlled weeds but injured onions.

MCP (2-methyl-4-chlorophenoxyacetic acid) in two reports on canning peas seemed to be safe at effective rates of sodium and amine salts. MCP is reported as safer on flax and more effective on mustard than 2,4-D. Yellow rocket in alfalfa requires more MCP than 2,4-D but effective rates of MCP are safer on alfalfa than effective rates of 2,4-D. Alfalfa tolerates low rates rather well and recovers from some injury. 2 lb. in pre-emergence applications in potatoes gave fair weed control and did not injure potatoes. In onions, MCP caused more injury than 2,4-D. Two pounds in one application is promising on Canada thistle. Results on buckbrush were poor at 1½ lb. and there was no control at 2 lb. on crabgrass but it killed white clover.

Chloro IPC (isopropyl-n-(3-chlorophenyl) carbamate) at 20 lb. gave good weed control in cherry orchard without injury to trees and gave good indications in three experiments on soybeans. Wild oats were controlled by working 8 to 15 lb. into soil but the crop tolerance situation is confused. CIPC is reported in several studies on sugar beets and red beets and in most cases results were not promising or were not equal to TCA. Wild oats with flax were not controlled with 2 and 4 lb./A. It gave fair control of foxtail but was not equal to CMU and endothal. Weeds were controlled in corn but yields were reduced, and in spinach grass control was good but spinach yield was seriously reduced on silt loam and muck soils. Residual toxicity studies show 2, 4, 6, 12 and 24 lb. to persist for 30, 60, 76 and 104 days in light soil and 44, 76, 90 and 148 days respectively in organic soil. pH of soil has effects on rate of loss of toxicity and low temperature prolongs activity.

Endothal (3,6-endoxohexahydrophthalate) as used here includes the several forms and formulations of this chemical. It was used rather extensively in various ways and with variable results on sugar beets but, in general, indications were good for weed control without injury to plants. Good results for control of wild oats were indicated in some trials. 4 and 8 lb. on red beets gave good weed control and no reduction in stand or yield of beets. The yield of snap beans was reduced significantly with 4 and 8 lb. and 8 lb. on potatoes in muck as pre-emergence application gave 65% weed control with no effect on stand or yield but 6 lb. caused severe injury to carrots. Soybean yields were reduced by 8 lb. but apparently not by lower rates. 2, 4 and 8 lb. in corn gave excellent results on

broadleaved weeds but poor results on grasses. It was one of best, however, in the control of foxtail in another trial. Four and 8 lb. in flax reduced stand and 1 and 2 lb. apparently did not control weeds. In wheat at boot stage 1 and 2 lb. caused 20 to 25% reduction in stand and higher rates caused severe injury and weed control was not good. Used on flax at pre-bud stage at 1, 2, 4 and 8 lb. and at bud stage at ¼, ½, 1 and 2 lb., a few weeds were controlled but most treatments were too harsh for these stages of growth. Applications of 2, 4 and 8 lb. on onions all gave fair to good weed control but reduced stand and yield of onions. On strawberries, 2 and 5 lb. reduced runner count and yield and on gladiolus 8 lb. gave good weed control without injury but weed control was not as good as with 2, 4-D or DN treatments. Weeds in cherry orchards were well controlled with 15 lb.

CMU (3-p-chlorophenyl-1-1-dimethylurea) was reported more than any other new material and uses and results were so varied that a concise summary is difficult. Weeds were controlled in various experiments with rates (lb/A) indicated. Crabgrass - 1,1, foxtail - 1,2, annual weeds - 1,2,1,¼,2,¼,2,1,½,1,1,2. In many of these experiments, 1 lb. was the lowest rate used. Failures are reported with 2 lb. on grasses and broadleaved weeds and in one instance crabgrass grew luxuriantly the same season after 40 lb. or less. Weed control was unsatisfactory on muck with 3 lb.

Control of perennial weeds is reported as follows: curled dock, chicory, perennial sow thistle, bladder campion, toad flax, with 40 lb. and field bindweed with 20 lb. Quack or couch grass completely controlled with 20 and 40 lb. The 20 lb. rate was slow but with both roots disintegrated. Other experiments gave 98% control with 50 lb., good control with 40 lb. and excellent with 60 lb, 90% with 54 lb. One interesting experiment reported complete kill from 10 lb. in April and 90% from 20 lb. in May. Leafy spurge was not controlled with 80 lb. in two trials and 100 lb. 80 lb. gave 90% control of hoary cress and horsenettle. On Johnson grass 50 lb. gave good control of established grass and there was no seedling emergence. Toad flax was killed slowly and fairly well with 54 lb./A. Eighty pounds gave no control of Russian knapweed.

Bulrushes, tops and all rootstocks attached to growing stems, were killed with foliage spray of 1604 ppm. Dormant root stocks were not killed. Complete control of weeds in irrigation ditches was attained with 5.66 lb/A. Railroad ballast was kept clean through a full season with 20 lb. CMU alone or 10 lb. with 80 lb. sodium chlorate or 10 lb. and 30 lb. TCA. The vegetation was quack grass and miscellaneous annual and perennial weeds.

Crop tolerance is a complicated story. Germination of sorghum and peanuts not affected by 1 lb. but damage developed when a few weeks old, 1 lb. caused slight yellowing of cotton when 6 to 8 in. high but did not reduce yield. One report indicates little effect from 3 lb. on corn, flax, oats and potatoes. Sugar beets, beans and peas seemed moderately tolerant. Turnips were killed by 1 lb. and red clover by ½ lb. Another worker reports sweet clover suppressed by ½ lb. and flax and barley by 1 lb. Wheat and oats tolerant of 2 lb. but all killed by 3 lb. Results on sugar beets were variable. 1) Two pounds did not reduce yield or sugar and a combination with TCA increased yield, 2) ¼ lb. and 1 lb. reduced stand 55 and 97%, 3) 1 and 2 lb. reduced stand and vigor, 4) ¼ to 2 lb. had no effect on weeds or beets, 5) ¼ lb. killed weeds and beets, and 6) 1 lb. gave excellent weed control but reduced stand 75%. Large seeded crops and those propagated by vegetative parts such as potato and gladiolus and transplants seem to be tolerant of 1 lb.

Red beets were not affected by 2 lb. in one case but stand reduced in another by ½ lb. Stand of snap beans reduced 80% by 3 lb. spinach was affected by 1 and 3 lb. proportionately and carrots may tolerate a little more than ½ lb. Onions were not affected by 1 lb. Other reports on corn show no ill effects at 2 lb., stand reduced at 2 lb. and no effect on sweet corn at 1 lb. Soybeans are apparently sensitive to CMU at 1 lb.

Cherry trees were affected by 20 lb. and many woody plants were injured at 80 lb. Wild rose, horsetail and big blue stem were not killed by 80 lb.

Residual toxicity apparently is persistent for long periods but definite and full information has not been reported.

Project V. New Herbicides

Abstracts of Results of Cooperators

A few abstracts on new herbicides are published here but most of those containing information on this subject have been included in other projects. Instructions from authors on where the abstract should be published were sometimes indefinite and it is hoped that none was omitted. A few may appear in two places.

Pre-emergence use of C.M.U. for control of annual grasses. Elder, W. C. and Gassaway, J. E. Rates of 1 lb. to 2 lb. per acre of C.M.U. were applied on several crops immediately after planting. 1 lb. per acre on sorghums and peanuts controlled crabgrass effectively. This rate of C.M.U. did not affect germination of the crop seed, however some damage to the crops appeared after the plants were a few weeks old. 1 lb. of C.M.U. per acre on cotton caused slight yellow color of the leaves when the plants were 6 to 8" tall. This injury evidently did not affect the cotton yield. In this test all plots were given required cultivation. The check plots not hoed permitted crabgrass to grow in the row and produced only 300 lb. cotton per acre. The untreated hoed plots and C.M.U. plots without crabgrass present yielded 750 lb. cotton per acre. In another preliminary test 1 and 2 lb. C.M.U. per acre were applied on planted cotton and immediately 1 to 2" of water was sprinkled on the plots. Some of the cotton plants on the 2 lb. plots showed severe injury a few days after emergence. The 1 lb. treatment discolored the first two leaves of some plants, however all plants made normal growth and appeared to recover from any injury. Crabgrass and yellow foxtail that was planted 1/2" deep between the cotton rows and many annual weeds present germinated and emerged, but all were killed completely within 10 days after emergence at the 1 lb. per acre acre rate of C.M.U. (Contribution of the Agronomy Dept., Oklahoma Exp. Station, Stillwater, Oklahoma).

Hydrazine derivatives of carbonic and thiocarbonic acids. Gausman, H. W., Rhykerd, C. L. and Hinderliter, H. R. Hydrazine derivatives of carbonic and thiocarbonic acids supplied by Dr. L. F. Audrieth of the University of Illinois Chemistry Department are being screened and evaluated. Two hydrazine derivatives tested thus far show promising herbicidal properties. One derivative appears to be selective for grasses. These chemicals are also being tested as fungicides and show promise in this respect. (Illinois Agr'l. Exp. Station, Urbana, Illinois).

Reduction of seed formation in common milkweed, Asclepias syriaca L. by maleic hydrazide. Grigsby, Buford H. A thick stand of common milkweed was sprayed with a 2 percent solution of maleic hydrazide when the plants were in the full bud stage. Growth of treated plants was stopped, some of the leaves developed chlorotic areas, but the flowers opened in a normal manner. Young seed pods were observed but they soon dropped and at the end of the growing season only one pod was found on 100 plants. In an adjoining untreated area there were 107 pods on 100 plants. These latter plants were approximately twice as tall as the sprayed milkweed. (Michigan Agr'l. Exp. Station and Weed Investigation Div. BPIS & AE.)

Pre-emergence weed control in soybeans. Haberman, W.O., Wangerin, R.R., Roos, E. S. Soybeans were planted June 6 and sprayed June 7 with PCP, sodium salt at 20 and 15 lb./A.; PCP, sodium salt combined with chloro-IPC at 10 and 2.5 lb./A. resp.; PCP, sodium salt combined with EH 1 at 10 and 1 lb./A.; Dow Premerge at 3 lb./A.; Premerge combined with chloro-IPC at 3 and 2.5 lb./A.; Premerge combined with EH 1 at 1½ and 1 lb./A.; and MCP, sodium salt at 1 lb/A. Plots

were 0.2 acre, triplicated and randomized. Heavy rainfall followed treatments beginning on night of June 7. Spray volume 33 gal./A. All chemicals formulated with water as carrier. Weed counts were made 33 and 54 days after treatments. PCP at both rates and in combination with chloro-IPC or EH 1 all gave good broadleaf weed control, significantly better than checks and other treatments. Beans showed stunting in all treatments with EH 1. Pre-emergence broadleaf control was observed up to 54 days. Crabgrass was controlled to a certain extent. Premerge alone and with chloro-IPC were significantly better than check but not as good as PCP alone and in combination. Neither Premerge plus EH 1, nor MCP, sodium salt showed significant difference when compared with check. (Ralston Purina Company and Monsanto Chemical Company, St. Louis, Missouri).

The effect of C.M.U. on annual weeds and on nine different crops when applied before emergence. Knowles, Geo. C.M.U. was applied at the rates of ¼, ½, 1, 2 and 3 pounds per acre on the following crops immediately after seeding:- corn, flax, red clover, turnips, sugar beets, peas, field beans, oats and potatoes. Effect on crops - C.M.U. at all of the above rates appeared to have little effect on corn, flax, oats and potatoes. Red clover was wiped out by all rates except the ¼ pound, and turnips by all rates except the ¼ and ½ pound per acre. Sugar beets, peas and beans appear moderately resistent to C.M.U., some plants survived even the heaviest rate. Effect on weeds - All the annual weeds present were controlled practically 100 per cent by the 2 and 3 pound rates of C.M.U. The one pound rate gave good control of these weeds for about one month after treatment. Rates of less than 1 pound per acre did not give a satisfactory weed control. The annual weeds prevalent in these plots were purslane, lambs'-quarters, red root pigweed, yellow foxtail, and barnyard grass. (Central Exp. Farm, Ottawa, Ontario).

The effect of C.M.U. on deep rooted perennials. Knowles, Geo. C.M.U. was applied at the rates of 20, 40 and 80 pounds per acre on the following deep rooted perennial weeds; curled dock, chicory, perennial sow thistle, bladder campion, toadflax, and field bindweed. All of these six weeds were effectively controlled by the 40 and 80 pound rates of C.M.U. The 20 pound rates gave almost 100 per cent control of all the above weeds except field bindweed. The stand of this weed was reduced by 50 per cent. It should be pointed out that the above treatments were on weeds grown in nursery plots. They are likely to be susceptible to lower rates of C.M.U. than the same weeds when growing in natural and more adverse conditions. (Central Experimental Farm, Ottawa, Ontario.)

The effect of C.M.U. on couch grass. Knowles, Geo. C.M.U. was applied on couch grass sod on May 5th at these rates, 20, 40, 80 and 100 pounds per acre. All these rates gave 100 per cent control of couch grass. This chemical acts slowly and for a time the 20 pound rate appeared too light. However, at the end of two months the control was complete for all rates. Examination of the couch roots showed complete disintegration. It appears that when C.M.U. is applied at the above rates the residual effect remains in the soil for at least four months. C.M.U. has been applied this fall at rates of 15, 20 and 30 pounds per acre on couch grass sod, on couch grass sod then ploughed down and on couch grass sod after ploughing. The residual effect of each of these treatments will be determined in the spring of 1952. (Central Experimental Farm, Ottawa, Ontario).

Application of Isopropyl-N-phenylcarbamate and Chloro isopropyl-N-phenyl-carbamate to flax at 3 locations, one each in N. Dak., S. Dak., and Minn. in 1951. MacDonald, W. P.,; Zinter, C. C., Slough, A. T. Liquid IPC (solvents ethylene dichloride and xylol), 2 lb. per gal. were applied at 2½, 5, 7½ lb. acid equiv. per acre. 40.6% Chloro-IPC (liquid) was applied at 2 and 4 lb. acid equiv. per acre. Both applied with water at 10 gal. per acre. Flax 3-5 inches in height and wild oats 3-5 in. in height. IPC injured flax and reduced yield at both rates. No significant control of wild oats with either chemical. (Agr. Dept., F. H. Peavey & Co., Minneapolis, Minn.)

The effects of Chloro IPC on various crops and its residual properties in various soils. Stevens, L. F., and Carlson, R. F. Soils of light, heavy, and organic types were treated with Chloro IPC at the rate of 2, 6, 12, and 24 pounds per acre, and leached each week with 1, 1½, and 2 inches of surface water. Toxicity, determined by the inhibition of germinating oats, persisted in the light and heavy soils for 30, 60, 76, and 104 days, and 44, 76, 90, and 148 days in the organic soil. Leaching did not effect this loss of toxicity. In another experiment the same soil types were adjusted to pH 3, 7, and 8.5 and the compound applied at the rate of 2 and 24 pounds. At the lower rate the acid soil lost its toxicity before the alkaline soil, while at the higher rate the opposite relationship occurred. The high rate in heavy alkaline soil lasted only 72 days. In a third experiment temperatures of 35 and 55°F. prolonged the time of persistance, with the 2 pound dosage lasting up to 6 weeks in the organic soil and more than 12 weeks for the light and heavy soil. Soil stored at 75°F. was not toxic after 2 to 4 weeks. A field comparison of IPC with Chloro IPC showed that IPC at the rate of 2, 6, and 12 pounds disappeared within 6 weeks independent of the dosage, while Chloro IPC was toxic from 8 to more than 12 weeks depending on the rate. Pre-planting, residual pre-emergence, and post-emergence treatments were made in the field to corn, sorghum, oats, rye, wheat, soybeans, red clover, ladino clover, and alfalfa at rates of 1, 3, 6, and 12 pounds. Post-emergence applications burned the foliage of all crops. Pre-planting and pre-emergence treatments were fairly satisfactory in the 1 to 3 pound range on sorghum and legumes, except red clover. Pre-emergence treatments up to 6 pounds proved very successful on corn. (Department of Horticulture, Michigan State College).

Effect of CMU and TCA on Scirpus sp. Viehmeyer, Glenn; Hervert, Fred; Rathke, Chris. On July 20, 1951, one of the bulrushes of the Scirpus group (Scirpus americana, Pres. or a closely related specie) were treated with foliage sprays of Sodium TCA and with CMU (3-p-chlorophenyl-1-dimethylurea). Plants were 3-4' tall at time of treatment. Water was used as the carrier and Vatsol used as a wetting agent. Plants were wet to the point of runoff. TCA at all concentrations killed the foliage within ten days. CMU acted more slowly but gave complete foliage kills. Readings of results were taken October 29, 1951, as follows. TCA 1416 ppm, no visible effect on rootstocks. TCA 2832 ppm, caused some injury to buds on the rootstocks, TCA, 5664 ppm. caused discoloration of tissue of the rootstock at point of attachment of the stem and considerable discoloration of the tissue of buds. CMU at 1604 ppm killed rootstocks attached to growing stems as did CMU at 3208 ppm. Rootstocks attached to growing plants at time of treatment were completely decayed. Indications are that two or more treatments will be necessary because of numerous dormant rootstocks that made no growth during the 1951 season. Such rootstocks appear unaffected by any treatment. (Univ. of Nebraska., PVPP & ID, Dawson County Noxious Weed District).

Weed control in irrigation laterals. Viehmeyer, Glenn; Hervert, Fred; Rathke, Chris. On July 20, Sodium TCA and CMU (3-p-chlorophenyl-1-1-dimethyl-urea) were used to control weedy grasses in permanent irrigation laterals. TCA was applied at the per acre rates of 4.98, 9.96, and 19.92 lb. per A.; CMU at 5.66, 11.32, 22.64 lb. per A. Grasses present were barnyard grass, Echinochloa Crus-galli, Beauv.; Yellow foxtail, Setaria glauca, Beauv. and Green foxtail, S. Viridis, Beauv. Plants ranged from newly emerged seedlings to plants 12 inches tall. Experimental design used, complete randomized blocks, replicated four times. Both herbicides at all rates gave adequate control. Kills were not total with TCA, but surviving plants were stunted and did not impede water flow. CMU at all rates gave total kills of all living plant material in the treated areas. This indicated that lower rates of CMU may be effective. Both herbicides were applied using a water carrier with Vatsol as a wetting agent. On October 29, 1951, final observations indicated a residual effect from the heavier rate of CMU. Because of the toxicity of the herbicides it appears advisable that they be used only in irrigation ditches that can be flushed, prior to irrigation of crops. The above results are preliminary and are not recommended for general use until additional investigation determines the effect upon crop plants irrigated from treated ditches. (Univ. of Nebr., PVPP & ID, Dawson County Noxious Weed District)

Weed control with CMU. Young, D. W. and Loomis, W. E. Effective vegetation control for one season has been obtained on railroad cinder ballast with the use of 20 pounds of CMU per acre. The vegetation controlled included quackgrass and miscellaneous annual and perennial plants. Comparable results were obtained when 10 pounds of CMU were replaced by 80 pounds of sodium chlorate or 30 pounds of TCA, sodium salt per acre. The addition of a wetting agent, an oil emulsion, 2,4-D, or a contact killer such as DNOC, sodium salt has not influenced the effectiveness of CMU as a soil sterilant. (Botany Dept., Iowa State College, Ames, Iowa.)

The use of sodium cyanamid as a top killing chemical in crops. Cooper, G. S. Soybeans: Sodium cyanamid (x5) applied at 5 and 10 lb. per A. in 40 gal. of water gave excellent results in defoliating soybeans, but 20 to 25 lb./A. were necessary to obtain a satisfactory weed control to permit combining. 20 lb. in 10 gal. water applied by air gave encouraging results. The addition of p.e.p.s. at the recommended rate resulted in a better control of grasses but delayed bean drying a few days. Corn: Sodium cyanamid (x5) applied at 20, 30, and 40 lb./A. in 40 gal. of water resulted in excellent top killing of corn. This top killing resulted in a drop of 10 to 14 percent moisture over check material. When applied at early dent stage no apparent loss of yield is evident. Complete analyses are not yet available. Birdsfoot trefoil: Sodium cyanamid applied at 25 and 30 lb./A. in 40 gal. of water resulted in sufficient top killing to permit direct combining in 5 days. There was also a decided delay in dehiscence of the pod. In mixed stands of trefoil and grass this chemical does not give sufficient grass control to be of any practical value. Its use is primarily limited to pure stands of trefoil grown for seed. The addition of p.e.p.s. permits the lowering of rates of chemical needed and delays dehiscence of the pod several days, however the drying time is also extended. Castor beans: Sodium cyanamid (x5) applied at 20, 30, and 40 lb./A. resulted in true defoliation of all older castor leaves, but did not injure the newly developed top leaves. A second application using 10 lb. per acre was necessary to control new growth. In any case no stem damage was noted. Pods ripen much faster on the defoliated plants and the addition of p.e.p.s. delayed pod dehiscence to some extent. Annual weed control in alfalfa: 20, 25, and 30 lbs. of sodium cyanamid applied in 30 and 40 gal. water, just after spring growth of alfalfa and annual weeds had commenced, resulted in good control

of young annual weeds until first cutting took place. The alfalfa showed chlorosis for the first 10 days but recovery was rapid and within 3 weeks growth had surpassed that of the check plots. Large acreage treatment is planned for 1952. (Illinois Agr'l. Exp. Station, Urbana, Illinois).

Response of field crops to CMU. Carder, A. C. Six rows each of Saunders wheat, Victory oats, Olli barley, Chancellor peas, Redwing flax and Arctic sweet clover were sown 7 inches apart and 24 feet long. Superimposed across the rows immediately after seeding were 6 rates of CMU: nil, ¼, ½, 1, 2 and 3 lb. active ingredient per acre. Emergence and early growth of the various crops were slow due to unseasonable cold and dry, windy conditions until early July when warm, torrential rains occurred which continued through July and early August. The initial storm caused overwash and deposition of seeds of annual weeds in such fashion that following germination weed control by the chemical was difficult to gauge. Recurrent rains delayed ripening unduly so that harvest data were not secured. Examination 3 months after treatment indicated that ½ lb. of CMU per acre suppressed the growth of sweet clover, while at 2 lb. and over the legume was entirely eliminated. The flax and barley were the next most sensitive indicating some reduction of vigour with the 1 lb. rate, while the peas, oats and wheat showed no effects at this dosage. At the 2 lb. rate only the oats and wheat showed any marked tolerance towards the chemical. Complete killing or severe injury occurred with all crops at the 3 lb. application. Here also, oats and wheat were least affected. Annual weeds such as shepherd's purse and flixweed appeared largely controlled by the ½ lb. per acre dosage. (Dominion Exp. Station, Beaverlodge, Alberta).

Weed control with CMU. Hoffman, Otto L. and Sylwester, E. P. Eighty pounds of CMU per acre gave 90% control of hoary cress and horse nettle. The remaining plants were spindly and yellow. There was no reduction in stand of leafy spurge when treated with 80 pounds CMU per acre. Quack grass was 100% dead from a dormant application in April of 10 pounds per acre. An application in the middle of May gave only 90% control at a 20 pound per acre rate. Several different kinds of brush (elm, hackberry, dogwood, gooseberry, boxelder, wild grape), were severely injured with 80 pounds CMU per acre. Thus, the material should be used for weed eradication only with extreme caution around valuable trees and shrubs. Perennial plants that were not killed with 80 pounds per acre of CMU were wild rose (*Rosa* sp.), horsetail (*Equisetum* sp.), and big blue stem (*Andropogon furcatus*). Plots treated with 80 pounds per acre of CMU were completely free of annual weed growth six months after treatment. Crab grass made a luxuriant growth on plots treated with 40 pounds per acre or less. Red root pigweed grew on plots treated with lower concentrations. Data on perennial weeds will not be final until next season. (Department of Botany and Plant Pathology, Iowa State College).

PROJECT VI--CONTROL OF WOODY PLANTS

Henry L. Hansen

SUMMARY

The close of the 1951 field season brought a very satisfying number of reports of research and investigative activities in the field of woody plant control. It is evident that there continues to be an increase of interest in the use of chemicals to help solve the brush problem on transmission lines, highway and railroad rights of way, pastures, forest plantations and management areas, in connection with land reclamation activities, and in the eradication of poisonous species and those acting as alternate hosts to various disease organisms.

The past year has seen much of this interest translated into action programs. Various agencies both public and private which have experimented for a year or two with brush control by chemical means are now proceeding with more assurance and on a larger scale of operation. Others who have held back awaiting evidence of results from the more adventuresome are now developing chemical brush control programs of their own.

In spite of this, the increased use of chemical tools has made it increasingly evident that much remains to be learned about how to use them. The reports received this year have dealt largely with the efficacy of the low volatile esters, the further possibilities of dormant season control, long period results from brush treatments of several years ago, and results obtained from MCP and CMU on several species.

During the 1950 season only a limited number of tests were made of the low volatile esters. This year they have been widely tried on almost all the common problem species. While only a few of these tests have been specifically designed to compare these chemicals with the older forms, nevertheless they appear to have been fully as effective and in some cases even better.

In the dormant season and basal spray tests the superiority of oils over water has been more conclusively demonstrated. There is also additional indication that dormant season applications may be more effective than growing season applications under some conditions.

Further evidence has accumulated that there are optimum rates of application for various chemicals on different plants and using different types of application. Beyond these rates the addition of more chemical does not increase effectiveness. Still unanswered is the question as to whether foliage sprays using relatively low concentrations of chemical and resulting in delayed mortality are more or less effective in reducing regrowth of rhizotomous species than are higher concentrations with their quicker action.

Aerial spraying for brush control is being tested in different regions and on different brush types. The limitations and possibilities are being increasingly well delineated. In this connection the main problem is to determine the effectiveness of low volume applications. Early progress was made in previous years on mesquite and sand sage. It has been interesting to note the greatly reduced spray volumes which are now considered effective on hazel brush, the primary brush species over the Lake States. Several years ago volumes in excess of 200 gallons per acre were considered necessary, while the tests of the past year using as little as 20 gallons per acre have been equally effective. Aerial spraying using 5 gallons or less per acre have recently been tried with results not yet assessed.

Reports have been received of tests of previously untried chemicals on barberry, the alternate host for cereal rusts. Both CMU and MCP were found to show some promise on this species when applied to the ground surface. CMU applied as foliage sprays, basal sprays or in powder form on the ground were reported effective on post and blackjack oaks. Tests of MCP on buckbrush, poplar, willow, rose, hawthorn and Saskatoon berry seem to indicate less effect than obtained from 2,4-D and 2,4,5,-T. On barberry and whitebrush, however, this material looked more promising.

The 1951 season did not produce anything radically new or startling in woody plant control. Perhaps this is too much to expect each year even in such a dynamic field. The ground applications reported on barberry, hazel and oak indicate an encouraging interest in trying something besides the conventional methods. It is hoped that further tests of this method of application will be made.

Perhaps the point of "maximum returns" has been reached in this field of research using the existing array of chemicals. The writer feels that further rapid developments are going to be dependent largely on two things, new chemical formulations and fundamental research along physiological and ecological lines. More fundamental information must be obtained as to the processes of translocation in woody plants. The factors affecting the entrance of the hormone type formulations into the plant leaves, stems and roots and their movement within the plant need much study. Development of more successful techniques of foliage sprays, bark, cut surface and ground applications are held back by a lack of fundamental information of this nature.

Relatively little is known of the processes of vegetative regeneration in the various brush species and of the factors controlling them. The woody species which are especially troublesome regenerate by means of stump sprouts, root collar sprouts, root suckers and rhizome suckers. Adventitious as well as dormant buds give rise to the new growth. Very little research has been undertaken as to the nature of these regenerative processes. The special significance of the root crown area has been noted by several investigators. The feasibility of applying herbicides to the ground rather than to the plant directly has not been well explored. Phytosociological effects of controlling some of the species in a mixed brush population are of great significance in forestry and have been almost entirely ignored in research. These and many other problems can be solved only if ecological studies of the plants themselves and their relationships with the various factors of the environment lay the fundamental groundwork.

Appreciation is expressed to those who have submitted abstracts or who have aided otherwise in the preparation of the material for Project VI of the Research Report for 1951. The cutting of the abstract stencils was done by the courtesy of the Minneapolis office of the Grasselli Chemical Department of the DuPont Co.

Two suggestions are made for the compilation of future abstracts to help avoid misinterpretation. First, the geographic location of the tests described should be included. Second, the identity of the plant dealt with should be made definite by including the correct scientific name.

Dormant basal treatments for the control of hawthorn. Coulter, L. L. The trunks of hawthorn bushes four to eight feet high were sprayed and thoroughly wetted with several mixtures in an area from the ground line up to a point 18 inches above the ground. Treatments were made January 17, 1950. Chemicals involved were the propylene glycol butyl ether esters of 2,4-D, 2,4,5-T and mixtures containing equal amounts of each. These were employed at concentrations of 4, 8, 16, 32 and 64 pounds acid equivalent per 100 gallons of spray in fuel oil. All treatments gave virtually complete top kill. No significant difference in amount of regrowth was noted between materials at concentrations of 8 lb. A.H.G. or higher and plants showing no regrowth two summers later ranged from 90-100 per cent in these treatments. 2,4-D at 4 lb. A.H.G. appeared to be slightly less effective than 2,4,5-T or the mixture. Examination of roots indicates considerable live tissue in 2,4-D treatments though they have not sprouted while this is less evident in 2,4,5-T treatments. The above ester of 2,4,5-T was ineffective when applied in water in concentrations as high as 40 pounds A.H.G. (Dow Chemical Co., South Haven, Mich.)

Dormant basal treatments for the control of osage orange. Coulter, L. L. The trunks of osage orange trees 15-20 feet high were sprayed and thoroughly wetted with several mixtures in an area from the ground line up to a point 18 inches above the ground. Treatments were made January 13, 1950. Chemicals involved were the propylene glycol butyl ether esters of 2,4-D, 2,4,5-T and mixtures containing equal amounts of each. These were employed at concentrations of 4, 8, 16, 32 and 64 pounds acid equivalent per 100 gallons of spray in fuel oil. 2,4,5-T or the mixture of 2,4-D and 2,4,5-T at 16 pounds A.H.G. or higher showed 80-100 per cent control with no regrowth two summers later. Lower concentrations were effective though somewhat erratic. 2,4-D was ineffective at any concentration. (Dow Chem. Co., South Haven, Mich.)

Basal and basal-notch treatments of live oak and Mohr's shin oak. Darrow, R. A. and L. S. Gleason. Trees of live oak (Quercus virginiana) and shin oak (Q. mohriana) two to six inches in diameter were treated basally up to 15 inches from ground level and in basal notches 4-5 inches apart with various herbicides in April, May, June, August, and October, 1950, and March, 1951. 2,4,5-T propylene glycol butyl ether ester and mixtures of 2,4-D and 2,4,5-T esters in diesel oil and 2,4,5-T amine in 50% oil emulsions were applied in concentrations of 0.6, 1.0, 1.4, 2.4, and 4.8% acid equivalent. Approximately 35 trees were treated with one gallon of spray solution. Ester and amine forms of 2,4,5-T were ineffective in basal applications on live oak but effective control of shin oak was obtained in August with 1.4% solutions of 2,4,5-T ester. Basal treatments with mixtures of 2,4-D and 2,4,5-T esters at 4.8% acid concentration were effective on both live oak and shin oak in August. Effective control of live oak and shin oak was obtained with 1.4% solutions of 2,4,5-T ester in oil applied in basal notches in August. In live oak, applications to basal notches during the dormant season gave better results than basal applications but the reverse applied in the case of shin oak. (Contributed by the Texas Agricultural Experiment Station, College Station, Texas)

Effects of aerial application of 2,4,5-T on post and blackjack oaks. Darrow, R. A. and W. G. McCully. Aerial applications of butoxy ethanol and propylene glycol butyl ether ester of 2,4,5-T, ethanol amine of 2,4,5-T and a mixture of 2,4-D and 2,4,5-T butoxy ethanol esters were made on eight 5-acre plots, June, 1950, in second-growth post and blackjack oaks six to fifteen feet in height. Herbicides were applied in 25% and 50% emulsions in concentrations of 3/4, 1, and 1.5 PPA at 4 gallons per

acre. 1½ PPA of a mixture of butoxy ethanol esters of 2,4-D and 2,4,5-T in a 25% emulsion gave 53-57% kill of post oak and 12-17% kill on blackjack oak. A 90% kill was registered for trees of both species under six feet in height with 1 PPA 2,4,5-T butoxy ethanol ester in a 25% emulsion; less effective results were obtained on larger trees. 2,4,5-T amine applied at 3/4 PPA was fully as effective as 1½ PPA, and when applied at the lower rate resulted in more than 50% kill of blackjack oak under six feet in height. (Texas Agricultural Experiment Station, College Station, Texas)

Effectiveness of 2,4,5-T on two species of prickly pear. Darrow, R. A., L. Reyes, and L. S. Gleason. Monthly tests were made from May to August, 1950, on Lindheimer prickly pear (Opuntia lindheimeri) at Beeville and on Engelmann prickly pear (O. engelmanni) near Sonora, Texas. Low-volatile esters of 2,4,5-T applied in oil or 50% oil emulsions at 1% acid gave fairly effective control of Lindheimer prickly pear in late summer applications. The most effective control of Engelmann prickly pear was obtained with late summer applications of 10,000 ppm. 2,4,5-T amine in a 50% emulsion and of a mixture of 0.6% 2,4,5-T ester and 0.5% dinitro compounds in diesel oil. There was some indication from current-season treatments that mixtures of 2,4,5-T amine and dinitro compounds in emulsions were more effective than 2,4,5-T alone. (Texas Agricultural Experiment Station, College Station, Texas)

Dormant season treatment of persimmon. Darrow, R. A. and W. K. Frey. Basal and cut-surface applications to common persimmon (Diospyros virginiana) were made in February, 1951. Treatments included 1,2,4 and 6% acid equivalent solutions of low-volatile esters of 2,4,5-T; 2,4-D, and equal mixtures of 2,4-D and 2,4,5-T esters in diesel oil and in 50% and 10% emulsions. 2,4,-D and 2,4,5-T amines were applied in like concentrations in 50% and 10% emulsions. Cut-surface applications of 2,4,5-T have given complete control of sprouting within the range of carriers and concentrations used. Ester and amine forms of 2,4-D were less effective than 2,4,5-T in basal and cut-surface applications. Basal applications of 4% 2,4,5-T ester and 6% 2,4-D ester in oil have given complete control of sprouting. (Texas Agricultural Experiment Station, College Station, Texas)

The effect of basal stem sprays on red maple and alder. Day, M. W. and R. E. Dils. A total of 80 red maple (Acer rubrum) and 80 alder (Alnus incana) were given basal stem spray treatments in July, 1950, using several formulations and concentrations, all in diesel oil. The results as judged one year later were as follows:

Formulation	per cent of alder still healthy, 1951	per cent of red maple still healthy, 1951
ACP 898-10,000 ppm	0	33
ACP 897-10,000 ppm	0	0
ACP 592-10,000 ppm	0	50
Weedone B.K. 10,000 ppm	0	20
Weedone B.K. 20,000 ppm	0	0
Dow Esteron 245-5,000 ppm	0	10
Dow Esteron 245-10,000 ppm	0	0
Dow Esteron 44-10,000 ppm	0	0

(Contribution of the Michigan Agricultural Experiment Station, Dunbar Forest Experiment Station)

The effect of basal stem sprays on aspen. Day, M. W. A total of 480 aspen (Populus tremuloides) trees were treated between March and July, 1951, using 3 formulations and 2 methods. All formulations were in diesel oil at 8000 ppm. The trees treated were between 5 and 10 inches in diameter. Treatment #1 consisted of spraying the trunk from the ground line to 4 feet high. Treatment #2 consisted of preparing a frill girdle at 1 foot from the ground and pouring the solution into the frill. The results were judged on August 28, 1951, and are enumerated below.

Formulation	Per cent still healthy	
	Treatment #1	Treatment #2
Dow A40	86	90
Dow Esteron 44	4	65
Dow Esteron 245	2	64

(Contribution of the Michigan Agricultural Experiment Station, Dunbar Forest Experiment Station.)

Effectiveness of several forms of 2,4-D, 2,4,5-T and MCP for the control of buckbrush. Derscheid, Lyle A. Duplicate square rod plots were treated with an alkanol amine of 2,4-D, an alkyl ester of 2,4-D, 3 low volatile esters of 2,4-D, an acetanalide of 2,4-D, an amine of 2,4,5-T, 2 low volatile esters of 2,4,5-T, 2 mixtures of low volatile esters of 2,4-D and 2,4,5-T, an alkanol amine of MCP, a low volatile ester of parachlorophenoxyacetic acid and Himmel's brush killer at rates of ½, 1, and 1½ pounds acid equivalent per acre. Himmel's was applied in oil but all others in 40 gallons of water per acre. Treatments were applied June, 1950 when buckbrush was budding. Readings were taken June, 1951. None of the treatments caused complete elimination but the 1½ pound rate of an alkanol amine of 2,4-D, an ethyl ester of 2,4-D, a polypropylene glycol butyl ether ester of 2,4-D, a butoxy enthanol ester of 2,4-D, a mixture of 2,4-D, 2,4,5-T and parachlorophenoxyacetic acid gave better than 80% control. The one pound rate of these same five compounds, the 1½ pound rate of a butoxyethanol ester of parachlorophenoxyacetic acid and acetanalide of 2,4-D and the two higher rates of a polyethylene glycol half ester of 2,4-D gave 55 - 70% control. All other treatments failed to give 50% control. The 2,4-D compounds consistently gave the best control, but there was little difference among the several formulations. (Contributed by the Agronomy Department of the South Dakota Agricultural Experiment Station)

Effect of CMU on oak-brush. 1/ Elwell, Harry M. Post-oak and black-jack, 2 to 6 inches in diameter, were sprayed with CMU by the basal trunk method on April 26, 1951, at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma. This material was applied in solution of one and two pounds per gallon of water. In another test, CMU powder was spread on the soil at the rate of one tablespoon per tree around the root crown. Other tests were made July 25 using 0.5, one, and two pounds per gallon of water. These solutions were used for both sprays on the foliage and basal trunk treatments. A test was also made August 20 with a tractor sprayer especially designed for basal trunk treatments. The solution contained 0.5 pounds of CMU per gallon of water.

These different treatments were all effective on both the post-oak and black-jack. In the earlier test the plants were defoliated and remained so throughout the season and there were no signs of sprouts from the roots. Leaves were beginning to discolor in the tops of the trees twelve to fourteen feet high ten days after the August treatment.

The CMU killed all grasses and weeds near the treated brush.

1/ Contribution Soil Conservation Service, Oklahoma A. & M. College and the Du Pont Company.

Spraying oak brush in the dormant season. 1/ Elwell, Harry M. This study was designed to determine the effectiveness of spraying the entire plants of oak brush during the dormant season with herbicides. Several treatments were made in 1949 and 1950 with both ground and aerial equipment at the Red Plains Conservation Experiment Station, Guthrie, Oklahoma and other locations in the State on post-oak and black-jack.

An airplane was used in March and April of 1949 to spray large trees with 3 pounds of acid (2/3 2,4-D and 1/3 2,4,5-T) in 15 gallons of water oil emulsion per acre. Again, in 1950, several airplane tests were made. Heavy esters of 2,4,5-T were applied at the rate of 1.5 and 3 pounds of acid in each of 5 and 10 gallons of diesel oil per acre respectively. A mixture of 2,4-D and 2,4,5-T was applied at the same rate.

The ground equipment used was a paint gun. Several areas of small brush were sprayed in January and March of 1949 with 2,4-D and 2,4,5-T and combinations of them in concentrations of 1, 2, and 4 pounds of acid in 15 gallons of diesel oil per acre.

Aerial and ground spraying of the entire oak plants during the dormant season did not produce effective control. The plants in all the areas treated produced practically normal growth in 1951.

1/ Contribution Soil Conservation Service and Oklahoma A. & M. College.

Dormant basal trunk treatments for the control of oak. 1/ Elwell, Harry M., Coulter, L. L., and Gibson, John W. Various esters and amines of 2,4-D and 2,4,5-T were applied to the basal 12" of trees 2-5 inches in diameter in the post-black jack-oak complex. Dates of application were November 30, 1949, March 27, 1950, February 14, 1951, and April 10, 1951. These tests were made on the Red Plains Conservation Experiment Station, Guthrie, Oklahoma. Water and water-oil emulsions were ineffective for carriers of the esters. In all instances the propylene glycol butyl ether ester of 2,4,5-T gave good top kill at 16 lbs. acid equiv./100 gal. of fuel oil. In 1951 tests where somewhat higher volumes were used comparable results were obtained with 3 lbs. acid equiv./100 gal. Similar results were obtained with the same ester of 2,4-D at 32 pounds acid/100 gal. and a high percentage of kill was obtained at concentrations as low as 16 pounds A.H.G. The glycol butyl ether ester of 2,4-D was superior to the isopropyl ester.

In the 1951 treatments the amine of 2,4-D in a water solution gave poor results at concentrations less than 64 pounds A.H.G. and at this concentration was satisfactory only in the spring. The amine of 2,4,5-T gave satisfactory control at 32 pounds A.H.G. in both winter and spring treatments. The volume of spray applied at the base of the tree appeared to be very important irrespective of concentration or chemical used.

1/ Contribution from Oklahoma A. & M. College and Soil Conservation Service, and Dow Chemical Company.

Selective herbicides controlled oak and increased production of grass and cattle. 1/ Elwell, Harry M. Brush control studies have been made with 2,4-D since 1945 on the Red Plains Conservation Experiment Station, Guthrie, Oklahoma. The earlier tests were foliage applications using a power hydraulic sprayer to saturate the leaves and twigs of all plants with 2,4-D in a water solution. This method was used to test several formulations. Some later applications were also made with 2,4,5-T.

Results of these studies prove that post-oak and black-jack have been 95 percent eliminated. The most satisfactory applications were during the full leaf and active growing stage of the plants. A good initial spraying followed by spot retreatments the second and third years prevented reinfestation. The method provided maximum protection for the soil by conserving the woody litter while the native grasses were developing a stand. Within two years the grass cover on most of the treated areas was equal or superior to that of the native grass land or the station. During a summer grazing period of 112 days in 1950, a chemically treated pasture produced 56 pounds of beef per acre, and the same area made 72 pounds in 1951. After removing the cattle in 1950, this pasture produced about 50 pounds of native grass seed per acre. This tract had little or no grazing value before treatment.

1/ Contribution Soil Conservation Service, Oklahoma A. & M. College, and Flying Farmer Foundation.

Effect of herbicides for basal trunk-treatment of oaks. 1/ Elwell, Harry M., Lacko, Edward F., and Jones, Warren F. The basal 10 to 20 inches of sapling post oak and black jack brush were sprayed in March, 1951, using butoxy ethanol esters of 2,4-D and 2,4,5-T; 2 methyl-4-chlorophenoxyacetic acid; and 2,4-D amine.

Best results were obtained from the butoxy ethanol esters of 2,4,5-T. Concentrations of 10.5 pounds in 100 gallons of diesel oil resulted in about 95 percent mortality. Concentrations of one-half this amount were not as effective, but 21 pounds A.H.G. of oil did not produce any better kills. Mixture of 10.5 pounds (2/3-2,4-D and 1/3-2,4,5-T) of this ester in 100 gallons of oil was not as effective as the 2,4,5-T. Top kills were about the same, but more sprouts were growing from the roots. Emulsifiable acid mixture of these two herbicides in oil was not any more effective than the ester formulation. Butoxy ethanol ester of 2,4-D alone in concentration of 28 pounds A.H.G. of oil was as effective as 10.5 of 2,4,5-T. Water-oil emulsion, composed of 10 and 20 percent oil reduced the effectiveness of each of these materials. The addition of pentacholorophenol and TCA in the formulations of isopropyl and sodium did not improve the effectiveness of any of these spray solutions.

Ester formulation of 2-methyl-4-chlorophenoxy acid were applied, but only fair results were obtained from 21 pounds A.H.G. of diesel oil.

Another type of herbicide used was 2,4-D amine applied at the rate of 48 and 64 pounds A.H.G. of water. Only the higher concentration produced good top growth control of post-oak. Neither of these concentrations produced satisfactory control of black-jack oaks.

1/ Contribution Soil Conservation Service, Oklahoma A. & M. College and American Chemical Paint Company.

Effects of basal and frill sprays on post oak and blackjack. Gassaway, James E. and Elder, W. C. Evaluations were made in August, 1951, of the effective top and root kill of herbicides applied at monthly intervals in 1949 and 1950 on post oak (Quercus stellata) and blackjack (Quercus marilandica). 2,4-D and 2,4,5-T and mixtures of the two were applied in concentrations ranging from 1/2 percent to 4 percent by weight in diesel fuel oil or kerosene, applying from 20 to 30 cc's of the mixture of herbicide and carrier to each tree. Applications were made as basal or frill treatments. As reported in 1950, 2,4,5-T esters killed a greater number of tops of trees over the entire period of treatments in both the basal and frill treated plots than did the esters of 2,4-D and were much more consistent in their reactions on the trees. Two percent 2,4,5-T or 2 percent 2,4-D + 2 percent 2,4,5-T applied in frills provided from 80 to 95 percent top kill when treated from August, 1949, to April, 1951. No resprouting was evident on these plots in 1951, indicating that there was a repression of this new growth for 1 year, resulting from the treatments. Lesser concentrations of 2,4,5-T gave unsatisfactory top kill, while greater concentrations gave no better control. Top kill on basally treated oaks was obtained from December, 1949, through March, 1950, where the trees were less than 3 inches in diameter, but basal treatments had little effect on larger trees. Even the smaller trees in 1951 resprouted profusely from the tree base and from lateral roots. Lateral sprouts often reappear 5 feet from the tree. In addition to new growth from the treated oak species, there appeared an undergrowth of sumac, buckbrush, greenbriars, and herbaceous weeds. (Contribution of the Agronomy Department, Oklahoma Experiment Station, Stillwater, Oklahoma).

Effects of 2,4-D and 2,4,5-T on Persimmon. Gassaway, James E. and Elder, W. C. Basal and frill treatments using 2,4-D and 2,4,5-T (amine and ester formulations) alone and in mixtures were applied monthly in diesel fuel oil on persimmon (Diospyros virginiana L.) from August, 1949, to date. Concentrations ranged from 1/2 percent to 5 percent and 5 to 10 cc's of the herbicide and carrier were sprayed on each frilled or basal treated tree. On trees frilled in the fall and winter of 1949 and treated with 2-1/2 percent 2,4-D ester + 2-1/2 percent 2,4,5-T ester as observed in 1950, gave excellent top kill, but in June of 1951, new basal and lateral sprouts appeared on all treated trees. Treatments of lesser concentrations also killed the tops, but allowed new sprouts to appear the first growing season following treatment, while the more effective treatments, as the previously mentioned concentration, delayed or repressed sprouting for 1 year. 5 percent 2,4,5-T ester, as a basal spray on 1 to 2 inch persimmon sprouts, gave excellent top kill when applied in the winter months of 1949, but here again the basal and lateral regrowth appeared in 1951. Some treatments gave effective top kill when applied in July and August of 1950, although sufficient time has not elapsed to determine the degree of resprouting from crown and lateral buds. Stump treatments have been relatively ineffective on persimmon at concentrations ranging from 1/2 percent to 5 percent. (Contribution of the Agronomy Department, Oklahoma Experiment Station, Stillwater, Oklahoma.)

Foliage spray applications on prickly pear cactus (Opuntia Engelmanni). Gleason, Lowell S. and Robert A. Darrow. The most effective controls of prickly pear cactus, in the Edwards Plateau region of Texas, were obtained with 2,4,5-T, propylene glycol butyl ether ester, or a mixture of 2,4,5-T, isopropyl ester and dinitro compounds. Top kills of 100 per cent were obtained with 2.0 per cent concentration of 2,4,5-T, propylene glycol butyl ether ester, or a mixture of 0.6 per cent 2,4,5-T, isopropyl ester and 0.5 per cent dinitro compounds. A solution of 2,4,5-T amine and a combination of various esters of 2,4,5-T with TCA, sodium salt, each gave promising results. MCP, butoxy ethanol ester; 2,4-D amines, ester and acids; PEP and DNOSBP

failed to give satisfactory results. Oils with high percentages of aromatic hydrocarbons were found to be superior to low aromatic oils as carriers for herbicides. Late summer applications of herbicides were more effective than spring or late fall treatments. Contributed by Texas Agricultural Experiment Station, College Station, Texas.

A test of ground application of 2,4-D under hazel brush (Corylus spp.). Hansen, Henry L. In mid July, 1950, an isopropyl ester of 2,4-D (Esteron 44) was applied to the ground under mixed brush in a jack pine stand in Hubbard County, Minnesota. Concentrations of 2000 ppm and 6000 ppm in water at the rate of 50 gal. per acre were applied as a medium spray from a back pack pump. The spray was directed toward the ground under the brush. However, some spraying of the basal portions of the stems was unavoidable.

At the same time, foliage spraying was done on brush in the same stand using the same isopropyl ester at 2000 ppm in water applied at the rate of 20 gal. per acre. An analysis of the relative effectiveness of these treatments on hazel brush has been made based on plot counts made on September 27, 1950 and August 17, 1951.

The following conclusions seem to be warranted from the data: (1) the ground application using 2000 ppm was approximately as effective in killing hazel as was the conventional foliage spraying. (2) the ground application at 6000 ppm was less effective than either the ground or the foliage applications at 2000 ppm. (3) the 2000 ppm ground application was much slower in its apparent effects than were the 2000 ppm foliage or the 6000 ppm ground sprays. (Contribution of the Minnesota Agricultural Experiment Station).

Invasion by red raspberry (Rubus strigosus) following spraying to control hazel brush. Hansen, Henry L. On July 24, 1948, a mixed brush forest understory of hazel with several minor brush species including a sparse sprinkling of red raspberry was sprayed with an ethyl ester of 2,4-D. Over 95% of the aerial stems of the hazel were killed. However, it was noted that the spray caused only light injury to the raspberry. Since then, the abundance of raspberry increased from approximately 2000 stems per acre before spraying in 1948 to over 17,000 living stems in 1951. In brush counts made on July 18, 1951, it was found that the proportion of raspberry on the sprayed plots was more than 5 times as large as on the control plots. This great increase in the abundance of raspberry would seem to be the result of eliminating the competition from the hazel brush which was much larger and more abundant than the raspberry before spraying. (Contribution of the Minnesota Agricultural Experiment Station).

Extent of recovery of beaked hazel (Corylus cornuta) four years after spraying. Hansen, Henry L. Counts have been made annually on permanent mil-acre quadrats located in a mixed aspen-pine forest in Itasca State Park, Minnesota, with a heavy hazel brush understory which was sprayed with an ethyl ester (Weedone 48) of 2,4-D in July, 1948. This 1948 spraying resulted in better than 95% kill of all aerial stems of the hazel. A comparison of the brush population on the sprayed and untreated plots follows.

Using the number of living stems present in the various size classes before spraying in 1948 as 100%, the following population changes have taken place during the subsequent 4 growing seasons:

Sprayed plots: 400% increase in number of stems 0-3' tall, 82% decrease in 3'-6' stems, 100% decrease in stems over 6'.

Control plots: 230% increase in number of stems 0-3' tall, 34% increase in 3'-6' stems, 53% increase in stems over 6'.

It is evident that although there has been a pronounced increase in the number of stems of all sizes on the control plots there are very few stems over 3' in height on the sprayed plots. This is of course a result of the 1948 spraying. However, there has been a 400% increase in the number of stems under 3' tall on the sprayed plots. Field observations reveal that these are largely shoots from the underground stems of hazel with some originating near the ground line of the dead aerial stems. Height growth of these shoots has been slow, and it is estimated that 2 more years will elapse before competition from them will seriously interfere with the young pine seedlings on the area. (Contribution of the Minnesota Agricultural Experiment Station).

Chemical weed control in forest firelanes. Kuntz, J. E., and Riker, A. J. Weed growth greatly reduces the effectiveness of forest firelanes located on the highly leached, rapidly drying, infertile Plainfield sand of central Wisconsin. Investigations in 1948-49 indicated promise with herbicides. Firelane weeds included quack and annual grasses; sedge; and chickweed, milkweed, spooted spurge, peppergrass, bindweed, sheep sorrel, lambs quarters, field asters, shepherd's purse, flowering spurge, and ragweed. Both 1950 and especially 1951 were unusually cool and wet. Regrowth of weeds in both treated and untreated plots was more abundant on the previously rototilled than on non-rototilled firelanes. Non-rototilled firelanes treated in April, 1950, with borascu (20 lbs./sq. rod, dry) or with a mixture of 2,4-D (isopropyl ester, 5 lbs./A., spray) and TCA (ammonium and sodium salts, 25 and 50 lbs./A., spray) showed sparse regrowth. Regrowth on rototilled firelanes was almost normal. Retreated 1950 plots and newly treated 1951 plots showed excellent weed control with borascu (10 and 20 lbs./sq. rod, dry) and concentrated borax (10 lbs./sq. rod., dry). In addition, plots treated in 1951 with CMU (20 and 40 lbs./A., spray), a mixture of 2,4-D (isopropyl ester, 4 lbs./A., spray) and CMU (20 lbs./A., spray), and a mixture of 2,4-D (isopropyl ester, 4 lbs./A., spray) and CIPC (10 lbs./A., spray) were practically bare at the end of the season. Response to CMU was slow; flowering spurge survived until midsummer. Mixtures of 2,4-D (isopropyl ester, 4 lbs./A., spray) and TCA (10, 25, and 50 lbs.A., spray) gave only fair control in 1951 as compared to excellent control (less than 5% of the check) in 1950. CMU, borascu, and concentrated borax caused severe injury not only to red pine transplants and to cottonwood cuttings planted in the firelanes but also to adjacent native northern pin oak and jack pine. (Contribution of the Wisconsin Agricultural Experiment Station in cooperation with the Wisconsin Conservation Department and the Nekoosa-Edwards Paper Company.)

The use of 2,4-D and 2,4,5-T in controlling woody plant growth on forest planting sites in Illinois. Ralph W. Lorenz. Mixed brush populations in Hancock county were largely eliminated from a forest planting site using a 1.5-percent solution of the oil concentrate of 2,4-D and 2,4,5-T emulsified in water as a foliage spray. The active ingredients in the oil concentrate were the isopropyl esters of 2,4-D, 2,4,5-T, 26.5 and 26.0 percent respectively. The distribution of woody plant species was as follows: elm, 141; bur oak, 85; hawthorn, 45; hickory, 37; shingle oak, 27; honey locust, 6; black cherry, 2; and basswood, prickly ash, hazel bittersweet, and buckbrush, 1 each. The heights of these woody plants ranged from about 3 to 12 feet. The first foliage spray was applied July 18, 1950.

The results of 350 observations as of June, 1951 were as follows: Plants with tops dead and no basal sprouts, 107; with tops dead and weak basal sprouts, 102; with partial foliage kill, 138; and with no apparent effect from spray, 3.

The area was resprayed on July 18, 1951. Results as of September 11, 1951, were as follows: Plants with tops dead and no basal sprouts, 290; with tops dead and weak basal sprouts, 48; with partial foliage kill, 12; and with no apparent effect from spray, 0.

The 2,4-D and 2,4,5-T mixtures can play an important role in removing hardwood "brush" competition from forest planting sites. A respray is highly effective in reducing sprouting to a mininum. (Illinois Agricultural Experiment Station.)

Response of white brush to herbicides. McCully, Wayne G. White brush (Aloysia ligustrina) has shown a positive but inconsistent response to foliage sprays of 2,4-D, 2,4,5-T and combinations of these in both ester and amine forms applied during the growing season. In general, the amine formulations seem to offer greater promise than do the esters. Combinations of 2,4-D and 2,4,5-T seem more effective than 2,4,5-T or 2,4-D alone, particularly when the esters are involved. Dormant spray treatments up to six pounds acid per acre of the low volatile ester forms of these materials in 10-20 gallons of oil resulted in very little effect. Results from current season treatments indicate a low-volatile ester of MCP may be more effective than any of the formulations listed above. (Texas Agricultural Experiment Station, College Station, Texas)

Basal and cut-surface applications of herbicides to post and blackjack oak. McCully, W. G. and R. A. Darrow. Post oak is more susceptible to basal treatment with various formulations of 2,4-D and 2,4,5-T than is blackjack oak. A mixture of second growth, predominantly post oak, showed complete top kill and approximately 50% had not sprouted 15 months after being basally treated in June, 1950. Low volatile esters of 2,4-D and 2,4,5-T used alone seemed equally effective at 25 pounds acid in 100 gallons of diesel on trees up to 7 inches DBH. Combinations of these materials applied in a like manner were less effective. CMU applied basally in April, 1951, at a concentration of 4.5% by weight in water gave excellent effect. The effect from June application of CMU was not as great as that exhibited by some other materials. The differential response of post and blackjack oak was not apparent in the April treatment using this compound. In tests at College Station, cut-surface applications of a mixture of low-volatile esters of 2,4-D and 2,4,5-T at 25 pounds acid in 100 gallons of diesel gave more consistent control of sprouts throughout the year than either 2,4-D or 2,4,5-T alone. February cut-surface applications of 2,4-D amine at 16 pounds in 10 gallons of oil and 90 gallons of water appeared to be highly effective in controlling sprouting. (Contributed by Texas Agricultural Experiment Station, College Station, Texas)

Toxicity of CMU to Allegheny and European Barberry. Melander, L. W., Wm. Watson, and Mac Campbell. Tests were made on Allegheny barberry in Virginia during April (plants dormant) and May 1951 (plants in leaf) with CMU (3-p-chlorophenyl-1, 1-dimethylurea) as a powder, and in water suspension. It was found that 1/2 pound per square rod applied as a water suspension was sufficient to give a practical kill. Since the translocation of chemical in these plants appears to be very slow, and since the toxic elements remain in the soil for some time, lower dosages may be adequate.

When this chemical was applied as a dry powder to the soil around the bases of European barberry bushes, it apparently was absorbed by the roots and translocated up to the upper parts of the plant. After the duff was cleared away, 1/8, 1/4, and 1/2 pound per bush were applied to the crown and to the soil around individual bushes. Bushes treated with 1/4 and 1/2 pound appear to be dead or dying. The action of the chemical on this species of barberry also seems very slow, so that definite conclusions cannot be made until another year has elapsed.

These results indicate that CMU may prove to be an effective herbicide for killing both of these species of barberry. (Contribution of Bureau of Entomology & Plant Quarantine, Agricultural Research Administration, U.S.D.A.)

Herbicidal Effect of MCP on European and Allegheny Barberry. Melander, L. W., Mac Campbell, and Wm. Watson. Compared to either 2,4-D or 2,4,5-T, the butoxy ethyl ester of MCP (2-methyl-4-chlorophenoxyacetic acid) seems to be more toxic to European barberry in Pennsylvania. In tests with oil solutions (12 and 24 pounds of acid equivalent per 100 gallons) of ester applied to numerous bushes, in both the dormant and foliage stages, very good kills were obtained. The chemical was applied principally at the ground line and to the surrounding soil. The roots appeared to be dead to the limits of the area of ground surface covered by the spray.

In a field test in Virginia, the butoxy ethyl ester of MCP at 12 pounds of the acid equivalent per 100 gallons on Allegheny barberry bushes in the dormant stage during April 1951 killed the above-ground parts with no apparent damage to intermingled grasses. It will be necessary to wait until next season to determine the effectiveness of this chemical in killing rhizomes. The lack of regrowth will be the indicating factor of completeness of kill.

These preliminary results warrant further field tests with the butoxy ethyl ester of MCP on both species of barberry. (Contribution of Bureau of Entomology & Plant Quarantine, Agricultural Research Administration, U.S.D.A.)

Use of 2,4,5-T and ammate in control of inferior hardwoods in the Missouri Ozarks. Nichols, J. M. The following tests are in progress on the University of Missouri Forest, Williamsville, Missouri: treatment of freshly-cut stumps of sassafras, persimmon, hickory, black oaks, and white oaks under the 4 inch diameter class with 2,4,5-T in a 5% solution with kerosene and ammate in a solution of 4 lbs. per gallon of water during each month of the year; basal spraying of sassafras, hickory, and oak sprouts with 2,4,5-T in a 5% solution with kerosene during each month of the year; winter and summer frill treatment of post oak and hickory in the 4 to 10 inch diameter classes with 2,4,5-T in a 5% solution with kerosene and ammate in a solution of 4 lbs. per gallon of water; foliage spray of oak and hickory sprouts with 1% and 0.5% concentrations of 2,4,5-T in water and 1 lb. and 0.5 lb.per gal. concentrations of ammate, all treatments with and without the addition of spreading and sticking agents. Only one year has elapsed for some of the tests and results are incomplete. No great difference in effectiveness of 2,4,5-T during the different months of treatment has been noted with satisfactory kill and reduction in sprouting in all cases except in stump treatment of oaks under 2 inches in diameter. Basal spray treatments have been definitely superior in initial kill and sprout reduction to the stump treatments for stems up to 2 inches in diameter. 2,4,5-T has thus far been somewhat superior to ammate, particularly in the year-round spraying schedule and in the specific case of persimmon which has consistently shown 100% mortality from stump treatment with 2,4,5-T. Hickory has been the most resistant species to both

chemicals in all types of treatment. The addition of spreading and sticking agents to the foliage sprays has yet to indicate any effects.

Winter treatment of woody plants. Owens, Clarence B., and Willard, C. J. A number of woody species in a heavily culled woodlot were treated with solutions of the polypropylene glycol butyl ether ester of 2,4,5-T and of a mixture of 2,4-D and 2,4,5-T (Brush Killer) (Dow) in Diesel fuel containing 10, 20, and 30 pounds acid equivalent of 2,4,5-T or the mixed acids in 100 gallons of solution in January, February and March. The solutions were liberally applied with a hand sprayer to the basal 24"-36" of the tree trunks. White elm, hickory, hackberry, hawthorn, beech, hop hornbeam, wild grape, poison ivy, and Virginia creeper were killed by the 10-pound solutions. White oak and white ash were killed by the 20-pound solutions. All species mentioned except poison ivy and Virginia creeper leafed out more or less and then died. There were no significant differences between January, February, and March treatments. Both Brush Killer and 2,4,5-T were effective. The Ohio State University, Columbus. (From M.S. thesis of senior author.)

REACTION of wild rose, hawthorn and Saskatoon berry to 2,4-D, 2,4,5-T and MCP. 1951. Pavlychenko, Thomas K. 10'x12' plots of rose (Rosa suffulta), hawthorn (Crataegus spp.) and Saskatoon berry (Ameliancher alnifolia) were treated in full foliage with 10,000 and 20,000 ppm. concentrations of MCP amine (Weedar); 2,4-D esters (Weedone Concentrate 48, ACP649); mixtures of 2,4-D and 2,4,5-T esters (Weedone Brush Killer 32 and ACP572) and with low volatile ester (Weedone LV4). RESULTS: On August 12th the foliage of rose was 100 pct. killed by ACP572, Weedone 2,4,5-T and at 20,000 ppm of Brush Killer 32 and Weedone LV4. Wood was mostly dead. From 5 to 10 pct. regrowth was present in all cases. ACP649, Weedone Concentrate 48 and MCP all were less effective. On hawthorn, foliage was 100 pct. killed by Weedone Concentrate 48, Brush Killer 32, Weedone LV4, ACP572, ACP649 and MCP. Wood remained green, even on small branches, excepting in Weedone Concentrate 48 plots. The foliage and stems of Saskatoon berries were 100 pct. killed in all plots excepting MCP, which failed to kill more than 20 to 40 pct. of leaves. It was impossible to give definite rating on reaction basis at this time and it will be given in 1952, when the final reading will be taken. (Contributed by Agr. Div., American Chemical Paint Co.)

REACTION of poplar, buckbrush and willow to 2,4-D, 2,4,5-T and MCP, 1951. Pavlychenko, T. K. Plots 10x12 ft. of poplar (Populus tremuloides), buckbrush (Symphoricarpos occidentalis) and willow (Salix spp.) were treated with 10,000 and 20,000 ppm. concentrations of MCP amine (Weedar); esters of 2,4-D (Weedone Concentrate 48 straight and diluted to 10 pct. acid equiv. with additional oil); ACP649; Weedone 2,4,5-T; mixture of 2,4-D and 2,4,5-T (Weedone Brush Killer 32 and ACP572) and with low volatile 2,4-D ester (Weedone LV4). RESULTS: All the chemicals used killed the foliage on willow 100 pct. Wood was also dead almost to the ground, with no regrowth. Buckbrush and poplar leaves were killed 100 pct. by Weedone Concentrate 48, Weedone Brush Killer 32 and at 20,000 ppm. by Weedone 2,4,5-T and Weedone LV4. Weedar MCP, ACP649 and ACP572 did not effect a 100 pct. kill at higher rates and were still less effective at the lower rates. Wood was killed mostly to about 1 ft. above ground in poplar and almost to the ground in buckbrush. The reaction rating in these plots will be made in 1952. (Contributed by Agr. Div., American Chemical Paint Company).

REACTION of dogwood, river birch, chokecherry and silverberry to 2,4-D, 2,4,5-T and MCP. Pavlychenko, T. K. Plots 10 by 12 ft. of dogwood (Cornus spp.), river birch (Betula nigra), chokecherry (Prunus melanocarpa), and silverberry

(Elaeagnus commutata) were treated with 10,000 and 20,000 ppm. concentrations of MCP amine (Weedar); esters of 2,4-D (Weedone Concentrate 48, straight and diluted to 10 percent acid eq., ACP649); Weedone 2,4,5-T; mixture of 2,4-D and 2,4,5-T (Weedone Brush Killer 32 ACP572) and with low volatile esters of 2,4-D (Weedone LV4). The chokecherry ranged from 2 to 5 and the other three species from 6 to 10 feet in height. RESULTS: In the fall, the foliage of silverberry was 100 percent killed in all plots. The wood was killed to the ground only in Weedone Concentrate 48. Weedone Brush Killer 32, ACP572, Weedone 2,4,5-T and Weedone LV4 killed the woody growth of 1951 but the older stems remained green. ACP649 and MCP caused only sickly discoloration of the wood. On dogwood the foliage was 100 percent killed by all the chemicals and concentrations used. Wood was only slightly injured by ACP572 and still less by ACP649 and MCP. Weedone Concentrate 48 gave 20, 2,4,5-T about 25 and Brush Killer 32, 40 percent wood kill. Weedone LV4 produced 50 percent kill, which was the highest kill on the species. In river birch plots, the foliage was 100 percent killed by all the chemicals. The foliage of chokecherry was also 100 percent killed by Weedone Concentrate 48 and Brush Killer 32 but only 70, 70, 90, 90 and 95 percent respectively by ACP649, MCP, 2,4,5-T, LV4 and ACP572. Wood of these species remained fairly green, with only small branches being killed. The final reading will be taken in 1952. (Contributed by Agr. Div., American Chemical Paint Co.).

Reaction of different woody species to 2,4-D and 2,4,5-T. 1950-1951. Pavlychenko, T. K. Several woody species were treated in 1950 at full foliage with mixtures of 2,4-D and 2,4,5-T (ACP572, Brush Killer 32, 2:1 and Dow Brush Killer, 1:1). 1 and occasionally 6 lbs./a. rates were used. ACP572 was applied in oil and the other two chemicals in water. RESULTS: The species that were successfully killed with one application were black currant, pincherry, black poplar and silverberry. They were rated Reaction I in 1951 and mostly Reaction I in 1950. Another group included species with considerable portions of the wood being killed, but where regrowth resulted from the roots or from the wood that was not completely killed. They were rated Reaction II in 1951 and Reaction II or I in 1950. In this group were: green ash, thorny buffalo berry, chokecherry, hawthorn, dogwood, gooseberry, hazelnut, honeysuckle, lilac, Manitoba maple, aspen poplar, rose, Saskatoon and willow. It is assumed that the regrowth can be controlled by subsequent treatments. Caragana appeared more resistant than any of the other species, as relatively little wood was dead at the end of two growing seasons and regrowth was quite abundant. This species was rated as Reaction II to III in 1951. The habit of growth, particularly the root system with horizontal creepers, determines to a large extent the amount of regrowth. A few species, particularly chokecherry, Manitoba maple, aspen poplar, hawthorn and silverberry, showed much more dead wood at the end of the second growing season than at the end of the first, indicating that the wood of these plants was killed slowly. Also, regrowth of these species often showed twisted sprouts with abnormal leaves, thus indicating the effects of the treatment on the following year's growth. (Contributed by Agr. Div., American Chemical Paint Co.).

Basal treatments of poplar, paper birch, river birch, dogwood and river willow. 1951. Pavlychenko, T. K. Large size aspen (Populus tremuloides) and paper birch (Betula papyrifera) trees and clumps of river birch (Betula nigra), dogwood (Cornus spp.) and willow (Salix spp.) were treated with 2,4-D ester (Weedone Concentrate 48); 2,4,5-T; and a mixture of the two (Weedone Brush Killer 32) at concentrations of 1,000 and 2,000 ppm. All herbicides were applied in oil to the bottom 3 ft. of the trunk until the spray began to run. Most of the species were in a semi-dormant state at the time of treatment. RESULTS: On September 7th, dogwood and paper birch showed no appreciable response to all herbicides, at both concentrations. River birch showed

abnormal blistering of bark at the base, due to proliferation of the phloem tissues, with both rates of the three chemicals used. The leaves appeared normal. Poplar showed varying responses. In the majority of cases, the bark of the younger trees was dead to 5 feet and occasionally to 3 feet above the spray line. Leaves were either dead or discolored. Only 10% of the poplar trees had a complete foliage kill. 2,4,5-T consistently showed to be the most effective chemical. It caused more leaf kill and the highest bark kill. Some of the older trees with very thick, rough bark were more resistant than the younger, smooth-barked trees. All the chemicals caused the lower 3 feet of bark to swell and crack. Under the swollen bark there was a slimy mass of tissue. River willow showed a similar reaction to the chemicals used with respect to both the leaf and wood kill. Final notes will be taken in 1952. (Contributed by Agr. Div., American Chemical Paint Company, Saskatoon, Sask.).

Dormant treatments of large boxelders with 2,4-D and 2,4,5-T mixtures. 1950-1951. Pavlychenko, T. K. In 1950, fourteen boxelders (Acer negundo) trees and four stumps, ranging from 8 to 14 inches in diameter, were selected for dormant treatments with 2:1 mixtures of 2,4-D and 2,4,5-T (Weedone Brush Killer 32 and a similar non-commercial formulation designated as ACP572). Deep snow in the spring of 1950 interfered with making these treatments before the last week in April, when the plant sap began to flow in spite of the ground being partially covered by snow. The treatments were made in oil with concentrations of 1,000 and 2,000 ppm. The trees and stumps were sprayed from the root crown to 3 feet up, until the spray began to run on the trunks. RESULTS: The foliage on the trees and stumps sprayed with Weedone Brush Killer 32 developed quite normally but was slightly discolored during the summer months and the apical growth on branches was arrested from the middle of June until fall. In 1951 the foliage was almost normal but all new growth showed typical 2,4-D twisting and discoloration. All the trees and the sprouts on stumps treated with ACP572 were very strongly discolored early in the season and lost their foliage early in September of 1950. In 1951 the trees and stumps never developed foliage nor produced sprouts. In the fall they also lost all their bark and began to decay. (Contributed by Agr. Div., American Chemical Paint Company, Saskatoon, Sask.).

Effect of 2,4-D and 2,4,5-T in oil applied as a basal spray to woody growth. Playfair, L. G. Three plots, 30 by 50 feet each, located some 35 miles north of Winnipeg, were knapsack-sprayed June 27, 1951. All plots carried a fairly heavy mixed growth comprised of: aspen poplar, balm of Gilead, burr oak, nannyberry, and wild rose. Growth over 4 feet was basal wand-sprayed to a height of 2 - 2½ feet on all sides, using sufficient material to allow some of the solution to run down the trunk; growth less than 4 feet was given full coverage, using a fan-shaped nozzle. Diesel fuel oil (medium) was used as a diluent, one ounce of acid being added to each 80 ounces oil; 1¼ imperial gallons solution was required for each plot, or at the rate of 72 ounces acid per acre. Plot No. 1 received an ester of 2,4-D; Plot No. 2, 50% 2,4-D, 50% ester of 2,4,5-T; Plot No. 3, 75% 2,4-D, 25% 2,4,5-T. An examination in late summer indicated a complete kill of all woody growth on all plots except No. 1 on which wild rose and nannyberry survived. Conclusions: (1) basal treatment proved highly effective; (2) the addition of 2,4,5-T seems advantageous only where resistant species are present. (Contribution of the Manitoba Power Commission, Winnipeg, Canada.)

Effect of basal sprays of 2,4,5-T on mountain maple. Roe, Eugene I. Dormant mountain maple (Acer spicatum) up to two inches in d.b.h. and 12-15 feet in height, growing as understory in an aspen-hardwood forest, were given basal sprays of 0, 1,

2, 4 and 8 percent solutions of Esteron 245 (polypropylene glycol butyl ether esters of 2,4,5-T) in No. 1 fuel oil in mid-November, 1950. The same concentrations (0, 5900, 11800, 23400 and 46100 p.p.m.) were also applied to similar shrubs in the same stand in early May, 1951 at a time when the buds were just beginning to open.

Examination in the following July showed complete initial kill had occurred of all maples given fall treatment with the herbicide and of those sprayed with 4 and 8% solutions in May. Those maples given 1 and 2% spray solutions in May showed somewhat less injury. Kill was also heavy in those shrubs sprayed with straight fuel oil in November although those similarly sprayed in May were not injured. Resprouting was appreciable following spring treatment, was much less important on the two weaker fall sprayings and completely absent on the stronger fall treatments. (Contribution of Lake States Forest Experiment Station, Grand Rapids, Minnesota).

Effect of time of spraying with 2,4-D and 2,4,5-T on resprouting of hazel. Roe, Eugene I. A second-year examination (Roe, 1950 Report - P.247) of thirtieth-acre plots of hazel brush sprayed at fortnightly intervals beginning in mid-June, 1950, with approximately 2400 and 4800 p.p.m. of 2,4-D, 2,4,5-T and 50-50 percent mixtures of these (all as polypropylene glycol butyl ether esters) showed that considerable resprouting has occurred on all plots. However, this was generally less on plots sprayed with 2,4-D than on those sprayed with 2,4,5-T or with 2,4,5-T in combination with 2,4-D. There was a strong tendency for resprouting to be heavier on plots sprayed in mid-June and in August than on those sprayed in July. Furthermore, hazel sprouts on plots sprayed in mid-June and in August were taller and more vigorous than those on the July plots despite the fact that the August sprouts had had a shorter period in which to develop.

Doubling the strength of the herbicides showed no consistent effect on either the amount of resprouting or the development of the sprouts. (Contributed by Lake States Forest Experiment Station, St. Paul, Minnesota).

Further studies of resistence of bog shrubs to spraying with 2,4-D and 2,4,5-T. Roe, Eugene I. A second-year examination of plots sprayed at Cohasset, Minnesota in July, 1950 with approximately 4800, 9600, 19200, and 38400 ppm of 2,4-D; 2,4,5-T; and 50-50 mixtures of the polypropylene glycol butyl ether esters of these confirmed a 1950 report of the great tolerance of Labrador tea. In all plots except where the highest concentrations of herbicides were used there are now more stems of this species than originally. The other common evergreen shrub, leatherleaf, showed greater mortality than it did in 1950 and only a moderate amount of resprouting. This species, now has less than 25 percent of the stems it had before spraying. Plots sprayed with 2,4-D showed best results.

In late October, 1950, additional small plots in the same swamp were sprayed with 0, 1, 2, 4, and 8 percent solutions of Esteron 245 in No. 1 fuel oil. Concentrations were 0, 5900, 11800, 23400, and 46100 ppm; application rate averaged 190 gallons per acre. An examination in July, 1951, showed that leatherleaf had been easily killed with no attendant resprouting by all levels of the herbicide. The more resistant Labrador tea was severely killed back by all strengths above 1 percent. It showed only minor recovery at the 2 and 4 percent levels and no recovery following spraying with 8 percent solution. There was also a minor amount of mortality to these and other species on the plot sprayed with fuel oil only. (Contribution of Lake States Forest Experiment Station, Grand Rapids, Minnesota.)

A comparison of 2,4,5-T and a mixture of 2,4,5-T and 2,4-D for the control of wild rose. Shulstad, O. H., A. F. Wiese, R. G. Robinson and R. S. Dunham. Square rod plots of wild rose in late bloom were sprayed with 1 and 2 lbs. per acre of 2,4,5-T acid and 1/2 and 1 lb. of 2,4,5-T acid equivalent in a mixture (ACP926) of 2,4-D and 2,4,5-T. Twenty gallons of spray were used per acre. All plots were then left undisturbed. A year after spraying, the plots showed satisfactory control but no complete eradication. No flowers developed on the few plants present on treated plots. There were no differences between chemicals or rates of application. (Contribution from the Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota. Paper No. 2749, Sci. Jour. Series, Minn. Agr. Exp. Station).

Scrub Oak control in central Wisconsin by use of ammonium sulfamate. Stoeckeler, Joseph H. and Robert C. Dosen. In a cooperative project on scrub oak control initiated in June, 1949, near Wisconsin Rapids, Wisconsin, good control of undesirable scrub oak was obtained, at reasonable cost, by use of ammonium sulfamate. Horizontal axe cuts were made near the base of the trees at the rate of one cut per 6 inches of circumference. A slightly heaped tablespoon of ammonium sulfamate crystals was placed in each notch. Treatment cost was a total of $2.49 per 100 trees; of this, $1.90 was for labor paid $1.21 per hour, and 59¢ was for chemicals at 16¢ per pound. The stand treated contained 402 scrub oak trees per acre in the range of 1-15 inches with most being 2 to 10 inches in diameter, and an additional 57 small clumps under 1 inch in diameter. Complete mortality, without any basal resprouting, was observed on 73.7 percent of all trees in Fall 1950 and 86.3 percent in Fall 1951. It was noted that about three-fourths of the trees which were tallied as living in Fall 1950, but which were then 80 percent or more defoliated, were completely dead in Fall 1951. It is yet too early to expect appreciable diameter growth response in the residual (625 per acre) sapling-sized jack pine; however, it was observed that in the 2-year period subsequent to treatment, jack pine reproduction from 1 to 3 feet high grew an average of 8 inches in the plots where scrub oak was poisoned, and only 4 inches on check plots where the oak was not treated. (Contribution of Northern Lakes Branch of the Lake States Forest Experiment Station, Rhinelander, Wisconsin and Nekoosa-Edwards Paper Company, Port Edwards, Wisconsin.)

Effect of 2,4-D, 2,4,5-T, and mixtures of these on woody growth. Wood, H. E., Shanks, G. L., Playfair, L. G., Sharpe, R. N., and Fuller, J. C. E. Field trials were continued during 1951, consisting of 1/16 acre plots mixed species (bur-oak, chokecherry, hawthorne, wild rose, honeysuckle, hazel, aspen poplar, willow, dogwood, saskatoon, wild plum), Buffalo turbine sprayed, using 2,4-D alone and in combination with 2,4,5-T at different rates (25, 50 and 75%) and in different amounts and kinds of carrier. Eleven plots were treated April 19, approximately a month before leafing became general. Diesel oil was used as a dilutent at 10, 20 and 40 gal. per acre; 9 plots received 2 lbs. acid per acre, one each 4 and 8 lbs. Spray solution was directed at the base of the growth but rose to a height of approximately 10 feet; some woody growth reached a height of 20 feet. In addition a number of large poplar and oak trees were basal-wand treated with 50% each 2,4-D and 2,4,5-T, 1 oz. to 80 oz. oil. A replicated series in the same area following the same pattern of dosage, except that water was substituted for oil, was made June 7 as foliage spray; likewise another single series using various company brands. On the foliage plots 1½ lbs. acid (varied at 3/4 lbs. and 3 lbs.) per acre was used rather than 2 lbs. in the dormant trials.

General conclusions drawn were as follows: (1) dormant treatment proved even more effective than foliage, and resulted in better penetration; (2) while less than 1½ -

2 lbs. acid per acre proved unsatisfactory, there appeared to be no advantage of higher rates; (3) 10 gal. diluent, especially oil, gave as satisfactory results as higher amounts; (4) except on such species as wild rose which are resistant to 2,4-D, the addition of 2,4,5-T seemed of doubtful value; (5) while taller trees leaved above the point where spray contacted, most of these failed to develop and died within a few weeks; wand dormant basal treated trees all died. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, co-operating with the Highways Branch, and the Manitoba Power Commission, Winnipeg, Canada.)

Project VII. Mechanical Considerations

Miscellaneous Mechanical Considerations — R. E. Larson

Summary

The several abstracts, submitted for inclusion in this section, as dealing with the mechanical problems of weed control cover a wide field. The variety of topics is such that it is impossible to write a summary which would combine the findings of such investigations. Therefore the abstracts are listed below to serve as a guide to the investigation results which are contained herein:

Ridge-planting of field corn and soybeans supplemented with pre-emergence herbicide applications (Collins, Lovely)
Self-propelled experimental high-clearance sprayer (Collins, Lovely)
Corrosive action of new herbicides (Larson)
A study of methods of 2,4-D application to alfalfa in oats (Larson, Miller)

Abstracts of Results of Cooperators

Ridge-planting of field corn and soybeans supplemented with pre-emergence herbicide applications. Collins, E. V. and Lovely, W. G. Basically, "ridge-planting" is listing and planting on the ridges rather than in the furrows. This type of tillage is superior as far as soil and water conservation is concerned and should give better stands and higher yields than conventional methods. Previously, this method of tillage was not feasible because of the difficulties encountered in controlling weeds.

Ridge-planting was included in one of our tillage experiments where comparisons are made of tillage methods with regard to fertilizer and/or herbicide applications in field corn. Amine solution of 2,4-D was applied at the rate of 2 pounds per acre 2 days after planting. The soil was very moist and showers occurred the following day. Three mechanical cultivations were made. Yield data are not available at this time. Early seasonal control of grassy and broad-leaf weeds was excellent but very little control of late-developing weeds was obtained.

Approximately 15 acres of field corn and 1 acre of soybeans were planted on field scale to further study this tillage method. Two pounds of 2,4-D Ester per acre applied shortly after planting, plus 2 mechanical cultivations when the corn was 15 and 24 inches high, gave excellent control of grassy and broad-leaf weeds throughout the season. Soybeans were planted in single rows and in triple rows 7 inches apart on top of the ridge. Half were given a pre-emergence treatment of 2,4-D Ester at the rate of 2 pounds per acre, and the other half a post-emergence treatment of EHI at the rate of 4 pounds per acre. These treatments plus 1 mechanical cultivation between ridges gave satisfactory weed control with the pre-emergence showing slightly better than the other. (Contribution of Department of Agricultural Engineering, Iowa Experiment Station and Division of Farm Machinery, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA)

Self-propelled experimental high-clearance sprayer. Collins, E. V. and Lovely, W. G. On the basis that high-clearance sprayers would not function well on sidehills and that the initial cost was prohibitive in a large number of cases, an attempt was made to develop an improved sprayer that would cost less. Previous experience has shown that the numerous heavy structural members required for the conventional tricycle-type sprayer accounts for a major portion of the expense. To reduce the amount of heavy structural members a motorcycle-type sprayer was con-

structed, with an outrigger balance wheel attached to a high-clearance frame. The costly heavy framework is kept as near the ground as possible and is compacted between the two motorcycle wheels. All the heavy parts of the sprayer (engine, transmission, tank, etc.) are mounted on this framework. Balance of the sprayer is maintained by the outrigger wheel that extends across two corn rows. The high-clearance frame connects the main part of the sprayer to the outrigger wheel and supports the boom. By incorporating parallel action into the high-clearance frame it is possible to keep the sprayer in an upright position even on steep sidehills. Preliminary field trials showed the need for some minor design changes and a general revamping of the machine. These trials also indicated that the fundamental ideas and design showed a great deal of promise. (Contribution of Department of Agricultural Engineering, Iowa Experiment Station and Division of Farm Machinery, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA)

Corrosive action of new herbicide. Larson, R. E. Tests are being run to determine the corrosive action of new herbicides on materials making up spraying equipment. Materials in the test include stainless steel, plain and galvanized steel sheet, 18-8 aluminum sheet, copper, brass, bronze, natural rubber, neoprene synthetic rubber and vinylite plastic hose. These metals are exposed to the herbicide under three conditions, namely, completely submerged, wetted and dried and in the air vapor above a solution. The chemicals are mixed in solutions whose concentration is as close as possible to the maximum that can be expected as a recommended dosage.

The most prominent of chemicals tested and which can be reported at present is TCA (sodium salt). This chemical was mixed at rate of 1 pound acid equivalent per gallon of water. Results of the tests have indicated the chemical is very corrosive to aluminum when it is in the solution in the presence of bronze, copper, and brass. The corrosive action is much less prominent when the aluminum is in solution alone or in the presence of steel, in fact, this action appeared negligible as compared to that in the first condition mentioned. The major portion of this action was on the submerged portion with the most severe of this corrosion appearing right at the point of the liquid surface level.

A field check of a sprayer, having an aluminum boom and having been used two days for spraying TCA, then cleaned by running through it two tanks of water, showed no corrosive affect of the TCA. (Contribution Division of Farm Machinery, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA cooperating with Division of Agricultural Engineering, University of Minnesota)

A study of methods of 2,4-D application to alfalfa in oats. Larson, R. E., and Miller, J. H. The variable factors studied in these trials were volumes of diluent, pressures, angle of spray delivery, and nozzle types. Ranger alfalfa and brome grass were seeded with oats. Radishes were also included to insure having a broad leaf plant to indicate weed kill. The applications were made when the oats were about six inches tall. The dimethylamine salt of 2,4-D was used at the rate of $\frac{1}{2}$ pound of acid per acre on all plots.

The following volumes with and without a wetting agent (polyoxyethyline sorbitan monolaurate) were compared: 10, 25, 40, 60, and 100 gallons per acre. The treatments, 60 with W.A., 100 with and without W.A, and 10 without W.A. appeared to result in a greater alfalfa survival than the other treatments. Of the above mentioned favorable treatments, the 10 without W.A. was somewhat less promising than the higher treatments.

In the pressure study, pressures of 15, 30 and 60 PSI were used on the same size

nozzle with speed variations to deliver the same gallonage per acre. Results from this study do not indicate a difference in alfalfa survival with various pressures used under the conditions of this experiment.

In the angle of nozzle delivery study, comparisons were made of possible methods of delivery. These methods included spraying perpendicular to the ground, parallel to the ground, and a point midway between the two. These results did not reveal any advantage for any one particular method.

The studies concerned with type of nozzle included fan and cone designs. Analysis of results show negligible difference between the two types. The rate of ½ pound of dimethylamine salt of 2,4-D caused severe injury to alfalfa stands and was effective in eliminating the indicator radish plants on all plots. (Contribution of Divisions of Farm Machinery and Weed Investigations, Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA cooperating at University of Minnesota Rosemount Experiment Station)

Project VII. Mechanical Considerations

Plot Sprayers

Lyle A. Derscheid

Summary

The abstracts submitted include explanations of pack-type sprayers, push-type sprayers, tractor-drawn sprayers and tractor-mounted sprayers. Each is self explanatory. This phase of the project was instigated in September; therefore, it is possible that some workers have been overlooked. If this is the case, the writer wishes to apologize.

Abstracts of Cooperators

A carbon dioxide powered sprayer for small plots. Buchholtz, K. P. Description published in Agron. Jour. 42:614. 1950. (Contributed by Department of Agronomy, Wisconsin Agricultural Experiment Station, University of Wisconsin.)

Low volume experimental plot sprayer. Cooper, D. J. This unit is mounted on two light wheels. A conventional open head hand sprayer serves as the pressure chamber. A six pint metal tank holds the solution. Pressure is supplied to this metal spray tank from the air pressure chamber which is pumped up by hand. An 8 foot adjustable boom is equipped with low volume, low pressure nozzles, spaced 12 inches apart. Two shut of valves are used, one between the pressure tank and the spray tank, the other is at the boom. An air release valve allows the pressure in the spray tank to be released quickly and speed up changing formulations. The operating pressure is approximately 30 pounds. Photographs and a list of parts of this sprayer are available. This is not a commercially built machine. It was made for Dominion Experimental Farms conducting weed control experiments. (Central Experimental Farm, Ottawa.)

Special push-type sprayer mounted on bicycle wheels for use on experimental plots. Derscheid, Lyle A. A 3/4" steel conduit frame was used to mount five liquid containers, a war surplus oxygen tank and necessary hoses, fittings etc. on bicycle wheels. The oxygen tank is filled with 125 psi of air by a compressor mounted in a pickup truck. The air is let out through a pressure regulator and a 3-way valve to any one of the four small or one large Fram oil filter cases. The pressure regulator is generally set at 30 psi. The 3-way valve will direct air from tank to filter case or will release back pressure from filter case and act as positive shut-off. The four small cases contain spray solution and the large case contains a flushing solution. Spray solutions are mixed in two small cases mounted on a stand in the truck. By rotating the six small cases, 2 men can mix as fast as one man can apply the spray. The boom covers a swath of 100 inches if all 5 nozzles are used. Three nozzles cover 5' or 2 nozzles may be used to spray 2 rows. The boom is adjustable for height from 20" to about 5', the pipes on which this adjustment is made are used for legs to prevent the aprayer from tipping when it is loaded in the truck. The boom is mounted on hinges so that it can be tipped to drain the nozzles. The hinges are offset so that when the boom is tipped, one end is higher than the other, this allows liquid to drain through valve on lower end. The wheel width is adjustable from about 3' to 5'. A speedometer is used to help keep a constant speed. Teejet nozzles and several sets of tips are used for different volumes. The writer is attempting to locate a small flowmeter so that it will be easier to determine amount of spray applied to each plot. Photographs can be obtained by writing the author. (Contribution of Agronomy Department of South Dakota Agricultural Experiment Station).

Parts list

Part	Manufacturer or Vendor	Cost
Labor of welder (14 hrs)		$ 21.00
20' 3/4" steel conduit	College Stores	2.20
6' ½" black pipe	College Stores	.54
9' 1¼" x 1/8 angle iron	College Stores	.45
2 Bicycle wheels, tires and tubes	Schwinn	14.50
1 War surplus oxygen tank	L. & P. Gas Co.	7.50
6 F-40 Fram oil filter cases	Fram	80.40*
1 F30-P2 Fram oil filter case	Fram	12.39*
1 Diaphram pressure regulator	Alemite	12.80*
1 pressure gauge	Alemite	.40*
1 speedometer	Stewart-Warner Corp.	25.00*
8 Speed couplers	Aro Equip. Corp.	12.40*
5 Teejet nozzles	Spraying System	5.00*
5 No-drip screens	Accessories Mfg. Co.	3.00*
5 Nozzle brackets	F. E. Myers and Bro. Co.	9.40
18' of 3/8" oil resistant hose	Gates	5.75*
3' of ½" oil resistant hose	Gates	1.20*
1 3-way brass valve	Plumber	1.00
16 hose clamps		4.80*
Misc. (fittings etc.)	College Stores	6.00
Total		$225.73
Air compressor (gas motor)	Sayler-Doll	128.25
Hose and pressure gauge		19.75
Total		$138.00

*Retail price, but a discount of 25% or greater was obtained.

Special trailer sprayer for use on experimental plots. Derscheid, Lyle A. Four round, 20-gallon tanks are mounted on a 2-wheel trailer with an axle that is extendable from 60" to 84". Each tank can be used for spraying independant of the others and can be completely drained. There are six levers at the front of the sprayer -- one for each tank, one for the valve controlling the booms at the rear, and one which directs liquid to outlet for a hand-boom. The boom is in two sections so that it can be folded for transporting. It covers a swath of 200" and is adjustable in height from 1½ to 5 ft. The hoses can be disconnected from booms and drained and booms can be drained by lifting the outer end and opening valve on inner end. Both sections of boom can be used at one time or either section can be used alone or both sections can be shut off for use of hand or brodjet boom. All liquid that goes to regular or to brodjet booms must pass through a flow meter which measures to the 1/20 gallon. It is possible to tell exactly how much solution was applied to each plot. A speedometer is used to facilitate calibration when a different tractor is used. The ¾" Oberdorfer brass-gear pump is driven by a Briggs-Stratton motor and a pressure gauge is used to keep constant pressure. A simple filter is used as a more complex one would be difficult to clean. Teejet nozzles are used so that Sprayjet or Teejet tips can be interchanged if a different volume is desired. Sprayjet tips are preferred because screens are screwed into tips and reduces clogging. Positive shut-off is obtained by use of no-drip screens in nozzles and by shutting off both sections of the boom. Photographs may be obtained by contacting the author. The sprayer was built by Fargo Foundry; consequently, a complete parts list cannot be given. (Contributed by Agronomy Department of the South Dakota Agricultural Experiment Station).

Parts list

Part	Manufacturer or Vendor	Cost
Sprayer	Fargo Foundry	$290.00
Trailer	Fargo Foundry	100.00
Tires and Tubes	College Stores	25.00
Flow Meter (Trident)	Neptune Meter Co.	60.00
Speedometer	Stewart-Warner Corp.	25.00*
Boom		
10 nozzle brackets	F. E. Myers and Bro. Co.	18.80
10 nozzles	Accessories Mfg. Co.	10.00*
10 no-drip screens	Accessories Mfg. Co.	5.00*
12 ft. oil resistant 3/8" hose	Gates	3.85*
12 ft. oil resistant ½" hose	Gates	4.80*
18 ¼" pipe nipples	College Stores	.90
18 hose clamps		5.40*
2 speed couplers	Aro Equip. Corp.	3.10*
Total		$551.85

*Retail price, but a discount of 25% or greater was obtained.

Experimental Plot Sprayer. Larson, R. E. and Miller, J. H. A plot sprayer has been designed to meet the needs of the research worker working on numerous small plots and with a variety of herbicides. The sprayer is based on the principle of using compressed air released through a diaphragm type regulating valve to the top of the liquid container. The liquid displaced from the bottom of the container is set to the boom through a standard steam whistle valve provided at the boom for quick shut-off. Specified spraying conditions can be obtained by easy adjustments of the pressure, speed and boom height and by solection of nozzles. The container mounting provides for easy and rapid refilling or change of chemicals. In three seasons operations the sprayer has indicated that it meets the requirements mentioned above but certain limitations have been evident. These are:

1. Mounting - When mounted on bicycle wheels difficulties were encountered in loose soil and rough terrain. The use of a garden tractor has helped alleviate these difficulties and provides a more uniform control of the speed.
2. Container - Quart size mason jars were used the first year and while immune to any corrosive action of the herbicide they would not satisfactorily withstand the internal pressures required. Modifications were made for the use of a plexiglass container which corrected the faults of the mason jars but show some limitation in the variety of chemicals which can be used in it. Thus for concentrated acetic acid, I.P.C. (emulsified) and 2,4-D acetanalide have been found to give some corrosive action on the inside surface of the container. A regular 2 gallon metal knapsack sprayer tank was provided for use on larger plots.
3. The cost of this spraying unit, less the means of transport, would be approximately $100. (Contribution of Divisions of Farm Machinery and Weed Investigations, B.P.I.S. & A.E., U.S.D.A.)

Parts list

Tanks (400 psi working pressure)	$ 8.00
Pressure regulating valve (diaphragm type 0-100 psi)	5.00
Pressure gauge (2)	6.00
Steam whistle valve	2.50
Nozzles	6.00
Plexiglass container	13.25
Container cover and mounting	10.00
Speedometer (bicycle type)	5.00
Gear reduction drive for speedometer	2.50
Hoses, fittings, structural materials, etc.	15.00
Labor (estimate)	25.00

Tractor-mounted experimental plot sprayer. Lovely, W. G. and Collins, E. V. In order to apply herbicides to a large number of experimental field plots (14 to 21 feet wide and 100 to 150 feet long), an experimental plot sprayer was constructed that could be mounted on the drawbar of a Ford-Ferguson-type tractor. This sprayer is very similar to commercial models of this type. The box-like metal framework that holds the spray tank and boom rests on the drawbar and is fastened to the hydraulic liftarms by means of J-bolts. Staybars can be used to keep the boom and tank at a constant height from the ground at all times or they can be eliminated and a quick vertical adjustment by means of the hydraulic lift can be made. A 55-gallon drum, or something smaller, can be used as a tank. To avoid boom whipping, a 1"x$\frac{1}{4}$" angle iron was welded to the 14'x3/4" pipe, and a truss-like framework was welded to the angle iron, further stiffening the boom. This straight one-piece boom is lengthened to 21 feet by means of 3$\frac{1}{2}$-foot pipe sections and couplings on each end. The boom bolts directly onto the box-like framework and vertical adjustment is made by means of a series of holes in the rear uprights. The pump attaches directly to the power take-off and maintains a constant output and pressure. The control panel is connected to the sprayer framework and the quick shut-off valve is operated by means of a rope fastened to the tractor fender. This sprayer gives accurate, even coverage without hand labor, it can be used for general weed and insect spraying on pastures, legumes, and row crops, it is easily transported from place to place, and it can be attached or detached from the tractor in less than five minutes. (Contribution of Division of Farm Machinery, Bur. of Plant Ind., Soils and Agric. Engineering, U. S. Dept. of Agric., and Dept. of Agric. Engr., Iowa Agric. Experiment Station.)

Experimental plot sprayer mounted on a garden tractor. Lovely, W. G. and Collins, E. V. This sprayer was constructed to obtain even distribution and coverage of herbicides on experimental plots with a minimum of hand labor. A freely pivoted support wheel mounted in front of the engine keeps the tractor on an even keel at all times without assistance from the operator. The front mounted 7-ft. boom with nozzle openings every 10$\frac{1}{2}$ inches makes it possible to obtain even distribution and coverage over a wide range of concentrations and gallonages. The governor-regulated gasoline tractor engine maintains a constant speed and further insures accurate coverage. A 5-gallon tank with a cover and a cylindrical suction-well 2$\frac{1}{2}$ inches deep, slung between the steering handles, makes an easily filled and cleaned spray tank that can be completely drained by the positive displacement gear pump that is pulley-driven from the crankshaft of the engine. The controls, quick shut-off valve, pressure regulator, etc., are mounted between the handles and are easily accessible to the operator. A metal spray shield with support wheels on the extreme ends fits over the boom and is moderately successful in preventing excessive drift. This sprayer is very successful on small plots and where a large number of chemicals are being used. It can be transported in a truck or pickup and is easy to operate. (Contribution of Division of Farm Machinery, Bur. of Plant Ind., Soils and Agric. Engineering, U. S. Dept. of Agric., and Dept. of Agric. Engr., Iowa Agric. Experiment Station.)

2,4-D sprayer used in field plot experiment. Olson, P. J. In 2,4-D and other herbicidal experiments at the University of Manitoba, Winnipeg, the size of individual plots is 3 rows wide and 18 1/2 feet long, (9 inch spacing). The sprayer used here is designed to give a uniform coverage of the chemical on plots of this size and minimize drift to adjoining plots. The essential features of the machine are as follows:

1. Carriage - Constructed from 1/2 inch steel pipe and mounted on two small wheels, in the general form of a two-wheeled wheelbarrow. The wheels were 1" wide and 1 ft. in diameter. The frame was constructed in such a way that other parts could be attached at convenient places.
2. Pressure tank - A knapsack sprayer tank is used to obtain the required pressure and is mounted near the front of the carriage.
3. Auxilliary cylinder - a small brass cup. (capacity 300 c.c.) is used for the chemical. It is mounted behind the pressure tank near one side of the carriage to facilitate easy removal and refilling. It is fitted with outlet and inlet connections.
4. Sprayer boom and nozzles - An adjustable sprayer boom 18" long is attached at the front of the carriage and is fitted with 3 nozzles, 9" apart; one for each crop row. The nozzles are high volume, angle 90°, flat spray pattern type. (Monarch #67).
5. Pressure gauge and shut-off valve - are located between the pressure tank and auxilliary cylinder. The gauge is near the pressure tank and mounted so as to be visible at all times. The stop-cock is located on the handle of the carriage and is easily manipulated by the operator.
6. Connections - All connections except the sprayer boom are of rubber tubing. The boom is made of 1/4" pipe.
7. Guards - Pieces of sheet metal (2' x 2') are attached on both sides of the carriage which guard against drift and serve as dividers for the crop rows.

At a walking speed of about 3 M.P.H. this sprayer gives a uniform coverage of the entire plot, and drift is considerably reduced. Photographs are available. (Contributed by Division of Plant Science, University of Manitoba).

Parts List

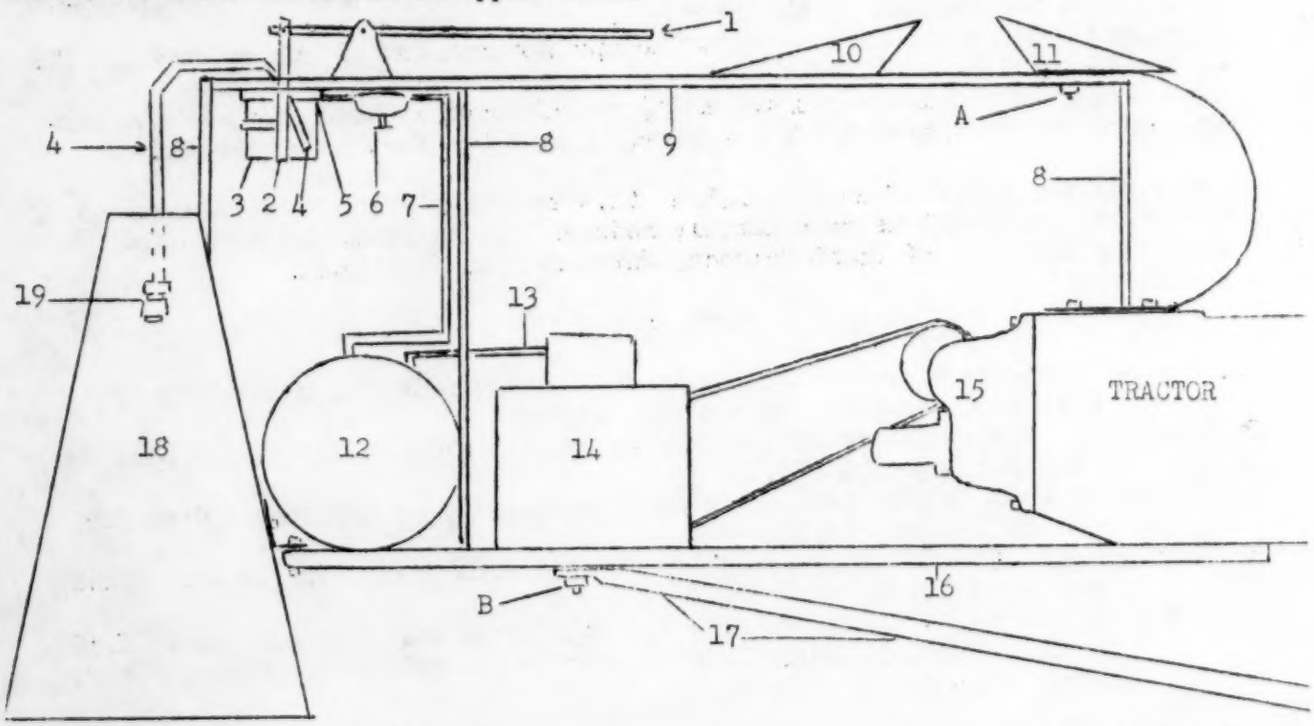
Carriage - constructed by the Agricultural Engineering Dept., University of Manitoba, Winnipeg, from scrap metal.
Pressure tank - Hudson Knapsack sprayer - purchased from Steele Briggs Seed Co., Winnipeg, cost $12.00.
Auxilliary cylinder - made by Machine Shop, University of Manitoba. Cost for material only - $3.50.
Pressure gauge - (0 - 100 lb. reading) purchased from Massey-Harris Co., Winnipeg, cost $3.00.
Nozzles (Monarch #67) - purchased from National Grain Co. Winnipeg, cost $1.50 each. (Total $4.50). Manufacturer is Monarch Manufacturing Works, Inc. Philadelphia, Penn.

A sprayer for experimental plots. Robinson, R. G. and R. S. Dunham. Description published in Agron. Jour. 42:58-9. 1950. (Contribution from Division of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. Paper No. 2501, Scientific Journal Series. Minnesota Agricultural Experiment Station).

HIGH SPEED PLOT SPRAYER; Pass,H.A., Skaptason,J.S., Howden,J.S. The sketch below illustrates a plot sprayer which was developed to fill a need for a sprayer which would spray accurately up to 400 plots per day, and which would be satisfactory for use in winds up to 15 miles per hour. In two years of extensive plot work it has been proven capable of spraying up to 100 plots per hour, with accurate application. With small changes the sprayer can be adapted to almost any combination of small tractor and air compressor, but has been used with a Massey-Harris 'Pony' and a two cylinder DeVilbis air compressor. This sprayer was built at a cost of less than $15.00, and without the facilities of a workshop.

The operation of the sprayer is as follows. By lifting handle (1) the basket (2) is lowered and spray bottle (3) is put into position. The handle (1) is then depressed forcing the bottle against a rubber gasket in seat (5) thereby effecting a seal. While maintaining the pressure on handle (1) the valve (6) is depressed and the air pressure forces the spray solution up pipe (4) and out through nozzle (19). The spray is instantly stopped by simultaneously releasing handle (1) and valve (6). The spray bottle is removed and a wash bottle substituted and the machine rinsed out. The sprayer is then ready for the next spray bottle and the nextbplot.

A separate solution bottle is used for each plot, and error is reduced to a minimum by preparing all bottles in the laboratory, and racking them in field order in s hallow boxes which are mounted on the tractor fenders. Spraying accuracy is ensured by governed tractor speed and constant pressure. Ease of cleaning is obtained by simplicity of construction and the extremely short solution line. With rod row plots one nozzle is used to spray two rows and a second added to spray 3 or 4 rows. Further details available on application.



1. Handle (strap iron 3/16 X 1") 2. Basket (strap iron) 3. Spray Bottle (4 or 6 oz.) 4. Pipe (copper tubing) 5.Sediment Bulb Seat (Automobile) 6. Air Valve 7. Air Line 8. Supports (1 X 5" fir) 9. 1X5" Board (fir) 10. Seat (implement) for sprayer operator. 11. Tractor Seat 12. Pressure Tank 13. Air Line 14. Air Compressor 15. Power Take Off 16. 2 X 10 plank 17. Tractor Draw Bar 18. Light Aluminum Hood 19. Nozzle A and B are points of attachment. (Contrib. Research Dept., Gree n Cross Insecticide Division, Sherwin Williams Co. of Canada Ltd., Winnipeg, Canada)

Small plot sprayer. Sexsmith, J. J. A small plot sprayer, a modification of the "Armstrong" sprayer sent from Ottawa, has been used successfully for two seasons. The unit is hand propelled, running on 18 inch bicycle wheels. Equipped with a pressure tank (war surplus airforce oxygen tank), regulator valve and gauges, the unit will apply spray solutions at constant pressure. The air supply (100 p.s.i.) is sufficient to handle 8 to 10 fillings of the chemical tank at a spraying pressure of 35 pounds. The tank holds 2½ quarts of liquid, enough for a 10 gallon per acre application to 4 replicates, spraying an 8 foot swath 20 feet in length. Rate of liquid applied can be changed by change in speed of travel, delivery pressure, or changing of nozzle tips. A bicycle speedometer with sprocket wheel running on tire edge gives a reading 10 times actual ground speed, and allows operator to maintain relatively constant speed. A possible addition would be a boom shield to allow for use on windy days. Appended is a list of the main parts of sprayer, available from motor supply and hardware dealers. Photographs and complete part lists are available. Contributed by Dominion Experimental Station, Lethbridge, Alberta.

Parts List for Small Plot Sprayer

Dominion Experimental Station - Lethbridge, Alberta

Quantity	Item	Price wholesale
2	Kellog air valve	6.80
1	#6825 Weatherhead shut-off	1.74
1	#145 " draincock	.60
2	#6892 " stopcock	2.50
1	#6829 " shut-off	1.88
1	#210 Aro speed coupler	2.30
2	#A2609 Aro connector	.90
1	#400 Webster regulator	5.80
1	0-200# Webster pressure gauge	2.90
2	0-100# " " "	5.80
8	#¼TT650067 Spraying Systems nozzles	8.80
	Pipe fittings and pipe for boom	8.70
	Air hose, clamps, valve stems, strap handles, spring, and miscellaneous bolts and washers	7.05
		retail
1	Bicycle speedometer	9.50
2	18" bicycle wheels	15.00
2	Tanks - oxygen - war surplus	10.00
	Iron for frame, etc. (36 lb. @ 10¢)	3.60
	Total cost	$ 93.87

Cost does not include labour charges or cost of chemical supply tank. For information regarding tank contact J. H. Armstrong, Central Experimental Farm, Ottawa.

An efficient sprayer for application of chemical sprays to experimental field plots. Shaw, Warren C. Description published in Agron. Jour. 42:158-60. 1950. (Contribution from Department of Agronomy. The Ohio State University, Columbus, Ohio and Ohio Agricultural Experiment Station, Wooster, Ohio).

Bill of Materials

No.	Size and description	Length	Use
1	1½" x 1½" x 1/8" angle iron	15'	Frame
1	1½" x 1½" x 1/8" angle iron	63'	Frame
2	1½" x 1½" x 1/8" angle iron	7 3/4"	Frame
2	1½" x 1½" x 1/8" angle iron	9 3/4"	Frame
2	1½" x 1½" x 1/8" angle iron	37"	Boom support
2	1½" x 1½" x 1/8" angle iron	30"	Rear legs
1	3/4" diam. pipe	63"	Push bar (frame)
2	1" x 1/8" bar stock	44"	Boom support
2	1" x 1/8" bar stock	34"	Boom support
2	1" x 1/8" bar stock	26"	Leg braces
2	1" x 1/8" bar stock	15"	Leg braces
1	1" x 1/8" bar stock	8 3/4"	Speedometer pulley brackets
1	1" x 1/8" bar stock	9 3/4"	Speedometer pulley brackets
2	1½" x ¾" bar stock	19 1/4"	Wheel support
2	1½" x ¾" bar stock	18"	Wheel support
2	1" x 1/4" bar stock	25"	Wheel braces
2	1" x 1/4" bar stock	15 1/4"	Boom support braces
1	1" x 1/4" bar stock	10"	Boom support braces
2	1" x 1/4" bar stock	5"	Boom support braces
2	1" x 1/4" bar stock	5"	Valve handles
2	1½"x1½"x1½"x1½"x1/8" bar stock	5"	Boom support brackets
2	1/4" diam. rod	46"	Valve operating rods
12	1/4" female nozzles		
12	1/4" check valves		
9	1/4" diam. pipe nipples	17 1/2"	Boom construction
15	1/4" pipe tees		
2	1/4" crosses		
4	1/4" plugs		
2	1/4" street ells		
8	1/4" globe valves		
2	1/4" quick action shutoff valves		
1	Pressure regulator valve		
2	Air pressure gauges 200 lb. capacity		
3	Air pressure gauges 100 lb. capacity		
2	Air pressure tanks		
2	Knapsack sprayer tanks		
2	Utility wheels		
7	5/16" diam. x 1" set screws		
1	Speedometer plus pulley		
	Rubber hoses and clamps for making the connections		
	Assorted bolts and nuts		

Project VIII — Basic Sciences

W. E. Loomis

Summary

The Manitoba group, headed by Dr. Olson, has added a great many new data to the important topic of stage of growth of grains and injury by 2,4-D. Barley and wheat follow the pattern previously reported by Derscheid of greatest injury during the two periods of early tillering and boot stage. Oats are reported to have shown one, longer period of injury rather than two. Still more work, closely tied in with the stage of meristematic development of the affected organs, will be needed for a complete solution of this important problem. Rodgers work with corn suggests two stages of injury to grain production, as previously reported by Staniforth. His data indicate, also, that brittleness is correlated with stage of development of the intercallary meristems of the basal nodes. Corn sprayed when the 4th to 7th nodes were growing rapidly developed brittleness, while plants sprayed earlier or later did not. Stage of growth seems to be dominant over rate.

Several important results are reported by Dr. Buckholtz and his students. The observations that adenine sulfate is antagonistic to 2,4-D toxicity and that 2,4,6-T is activated by low concentrations of 2,4-D are clues to the problem of the exact physiological effect of 2,4-D. The effectiveness of activated charcoal as a seed protectant may solve the present problems of pre-emergence sprays.

Dr. Grigsby reported no increase in the HCN content of sprayed wild cherry leaves. He did not, however, test the effects of 2,4-D on palatability and on rate of cyanogenesis shortly after spraying. Spurge leaves, like many other plant materials, yield an extract which has growth inhibiting powers. Dakota workers report that endothal is effective against wild oats, and Michigan workers find Chloro-IPC more persistant in the soil than the non-chlorinated product. This relationship seems to be common to many aromatic compounds.

A report from Kentucky on what appears to be a new and troublesome weed, and from Indiana on the seasonal development of the seedling and older Johnson grass plants as a basis for their control, completes our material for the year.

Abstracts of Results of Cooperators

Synergistic effect of 2,4-D in mixtures with 2,4,6-T. Behrens, Richard, Buchholtz, K. P. 2,4-6-Trichlorophenoxyacetic acid (2,4,6-T) has been believed to be nearly inert physiologically. To determine if this were true in the presence of 2,4-D, soybean plants were dipped in solutions of suitable concentrations when the unifoliate leaves were fully expanded. The sodium salts of both 2,4-D and 2,4,6-T were used. Concentrations of 2,4-D were 50, 25 and 12.5 ppm. 2,4,6-T was used at 50 and 25 ppm. The 2,4-D and 2,4,6-T mixtures were 25 plus 25, 12.5 plus 12.5, 6.25 plus 6.25 and 6.25 plus 50 ppm. respectively. Vel was used at 0.2 percent as a wetting agent in all solutions. Each treatment consisted of a pot containing three plants and 10 replicates were used. All growth above the unifoliate leaves was harvested 12 days after treatment.

Average weight yields in grams were 1.78, 2.51 and 3.29 for the 50, 25 and 12.5 ppm of 2,4-D. The 50 and 25 ppm of 2,4,6-T yielded 3.12 and 3.29 grams. The 25 plus 25, 12.5 plus 12.5, 6.25 plus 6.25 and 6.25 plus 50 ppm mixtures of 2,4-D

and 2,4-6-T gave yields of 1.56, 2.51, 2.89 and 1.47 grams respectively. The yields obtained when using the mixtures were not significantly different from those obtained when the entire concentration consisted of 2,4-D. Since 2,4-6-T alone was shown to be essentially inactive the mixtures appear to have produced a synergistic effect. Two additional trials gave comparable results. (Dept. Agron. U. Wis.)

Reaction of wheat to 2,4-D applied at different stages of growth. Friesen, George; Olson, P. J.; and Breakey, W. J. Butyl ester of 2,4-D was applied to Redman wheat at the rate of 8 ounces acid equivalent per acre, on each of 20 dates, starting 4 days before emergence and continuing at approximately 3-day intervals until the crop was well past heading. The experiment was conducted at Winnipeg and Morden and was a continuation of one began in 1949 and repeated in 1950. On account of a prolonged drought in spring the germination of the crop at Winnipeg was very ununiform and yield variation and consequent error large. (Necessary difference 16.48 bu.). At Morden very satisfactory conditions prevailed (necessary difference 3.87 bu.). At Morden sharp and highly significant reductions in yield took place at the 2nd. 3d. and 4th. stages, (plants 3½ - 5½ inches tall), and at the 14th stage (boot stage, approximately 8 days before heading) reduction somewhat less in degree, but still significant, occurred. At Winnipeg, although none of the yield reductions were statistically significant, the pattern of results was almost identical with that established at Morden. The results showed good agreement with those obtained in 1949 and 1950. (Div. Plant Sci., Manitoba, and Dom. Exp. Sta., Morden.)

Reaction of oats to 2,4-D when applied at different stages of growth. Friesen, George; Olson, P. J. and Brown, D. A. Butyl ester of 2,4-D was applied as a spray to Ajax oats at 8 ounces pure acid per acre at Winnipeg and at 4, 6 and 8 ounces at Brandon. The applications were made shortly after seeding and before emergence and continued at intervals of approximately 3 days until 20 applications had been made at Winnipeg and 19 at Brandon. Sharp yield reductions were recorded at both places over a period of 15 to 18 days when the plants were advancing from 6 to 7 inches (4 to 5 leaves) to 13 or 14 inches in height (shot blade). At Winnipeg the greatest reduction amounted to 42 bushels per acre (Necessary difference 21.5 bu.) and at Brandon to 29 bushels (necessary difference 8.7 bu.). The drop in yield between the 7th and 8th treatments at both Winnipeg and Brandon was very abrupt, as was the rise between the 12th and 13th treatment at Winnipeg and between the 13th and 14th at Brandon. The yield reduction was most severe for the 8th and 9th treatment at Winnipeg. At Brandon the lowest yields were recorded for the 8th treatment under each of the 4, 6 and 8 oz. rates. At Brandon, smaller tho significant yields reduction took place for the 4th, 5th and 6th treatment (plants 2 to 3½ inches tall) in the case of the 8 ounce rate. The 4 and 6 ounce rates caused no significant reductions for these stages. The Winnipeg data showed no significant reductions for these stages. These results agree very well with those for both sites in 1950 and seem to establish that the most vulnerable stages in oats occur from about the 6 or 7 inch stage (4 or 5 leaves) to the very early boot stage.(Div. (Plant Science, Manitoba, and Dom. Exp. Sta., Brandon).

Effects of herbicides on hydrocyanic acid content of Prunus serotina, Ehrh. leaves. Grigsby, Buford H. Wild black cherry trees, 8 - 12 ft. in height were sprayed with 2,4-D, 2,4,5-T, a mixture of equal parts of these two compounds, and ammonium sulfamate. The concentration of the growth regulators was 2,000 ppm and that of the ammonium sulfamate was 1 lb. per gal. A commercial sticker-spreader was added to all spray solutions and the foliage sprayed to the drip point. Samples of leaves were taken before spraying, 8,16,24, and 48 hours after spraying. Additional

samples were taken at 7 and 14 days. All samples were analyzed by steam distillation and titration against silver nitrate solution (Official method) as rapidly as possible after sampling.

The HCN content was found to be greatest at the time of spraying and decreased steadily until the leaves became yellow and dry. The decrease in HCN was most evident in the ammonium sulfamate treated trees and all lots had less than was found in untreated samples harvested at comparable times. These results indicate that wild cherry did not become more toxic to livestock when sprayed with the herbicides used in this experiment. (Mich. Agr. Exp. Sta. and Div. Weed Invest., BPI, S & AE)

Wild sorghum, a serious new weed on overflow land. Hansen, J. R. Wild sorghum or wild broomcorn is a serious pest in the Ohio and Green river bottoms of Kentucky. In some areas this weed, an annual, is considered to be more serious than Johnson grass. In Henderson County, Kentucky, some growers report reductions in corn yield of 30 to 40 per cent. Although proper classification of the plant has not been obtained, there is popular belief among farmers that the wild sorghum is the result of crosses between broomcorn and some cultivated sorghum. This is not unreasonable since plants resembling both types are common in variable populations of these weeds. Some heads resemble broomcorn, while others are more like the amber sweet sorghums. Plant height ranges from 4 to 10 feet, stalks have dry but semi-sweet pith, often exceed 1 inch in diameter, and most plants sucker at the upper nodes. The plants reproduce by seed, and seedlings have unusual vigor as compared to other sorghums. Seedlings were observed emerging through 4 inches of a light bottomland soil. The weed is most serious in drilled corn where seedlings come up in the row with the crop. One method of control practiced at present consists of rotating corn and soybeans and preventing seed formation by clipping with a cutter bar above the soybeans. (Kentucky Agr. Exp. Sta.)

Corn seedling response to 2,4-D as affected by certain nutrient salts and organic metabolites. Hansen, J. R. and Buchholtz, K. P. Attempts were made to reverse or alter 2,4-D toxicity by supplying certain nutrient salts and organic metabolites to corn seedlings. Materials investigated in one or more experiments included ammonium sulfate, potassium nitrate, potassium phosphate, glucose, sucrose, potassium hexose-di-phosphate, sodium glycerolphosphate, potassium pyruvate, potassium citrate, potassium alpha keto glutarate, potassium malate, ascorbic acid, potassium glutamate, potassium aspartate, adenine sulfate, and riboflavin. Seeds were germinated and seedlings were grown for 7 days in 8-inch test tubes containing 15 ml. of a 1 per cent agar solution with the desired concentration of 2,4-D and salt or metabolite.

Partial reversal of 2,4-D toxicity to seedlings was obtained with adenine sulfate, glycerolphosphate, and ammonium sulfate. Adenine sulfate reversal appeared to be the most specific in reversing 2,4-D toxicity, and there seemed to be a mutual antagonism between the herbicide and adenine sulfate. Glycerolphosphate was only effective at high pH levels, such as pH 6 or higher. Ammonium sulfate reversal, while consistent in work with agar media, could not be confirmed by nutrient sand culture experiments. A reversal of toxicity by riboflavin was found to be an *in vitro* inactivation of 2,4-D by riboflavin in light. (Dept. Agron., U. Wis.)

Prevention of 2,4-D toxicity to seedlings with activated carbon. Hansen, J. R. and Buchholtz, K. P. Activated carbon (Norite A) was applied to seeds of corn, soybeans, and peas by coating seeds with suspensions of Norite A in 3 per cent Dow Methocel or by placing the loose carbon in the soil above the seeds. Suspen-

sions of 10 and 20 per cent were used to coat all species. Loose Norite was applied mixed with an equivalent of 200 pounds of peat soil at rates per acre of 5 and 10 pounds to corn and 5, 10, and 20 pounds to soybeans and peas. Each species was planted in an individual randomized complete block arrangement with three replicates. In each 2 by 10 foot plot, 50 corn kernels or 100 soybean or pea seeds were planted in two rows. The butyl ester of 2,4-D was applied at acre rates of 8 pounds on corn plots and 4 pounds on peas and soybeans. Plots were irrigated after 2,4-D treatment, but also received heavy rains prior to emergence of seedlings. Peas were nearly eliminated by 2,4-D in absence of a protectant, but stands of 55 and 41 per cent of check were obtained with 20 pounds of loose Norite and the 20 per cent coating respectively. Stands of soybeans were reduced 50 per cent by 2,4-D with no Norite. A 20 per cent coating and 20 pounds of loose Norite allowed stands of about 85 per cent of the check. The Norite was relatively less effective on corn since good stands of corn were obtained even with 2,4-D treatment in the absence of Norite.

In another experiment, 15 pounds of Norite above the seed, where a 2 pound application of butyl ester of 2,4-D was made prior to crop emergence, allowed yields of soybeans for hay double that of the uncultivated, unsprayed check and three times that of plots sprayed with 2 pounds 2,4-D but with no carbon. (Dept. Agron. U. Wis.)

A method for the subterranean application of 2,4-D type herbicides for the control of leafy spurge (Euphorbia esula). Heggeness, H. G., and J. H. Miller.1/ Foliage applications of 2,4-D type herbicides usually kill the aerial portions of leafy spurge but do little permanent damage to the underground parts. Therefore, attempts were made to place the herbicides in the vicinity of the active roots.

The sodium and amine salts of 2,4-D, the ester of 2,4-D and 2,4-D acetanalide were applied in a pasture heavily infested with leafy spurge. The chemicals were mixed with rye seed and drilled into the soil at a depth of about 3 inches (maximum obtainable with facilities at hand) in July. The rates of application included 2,4,8,12,16, and 32 pounds of acid per acre. Injury was apparent on roots of plants still living this fall which suggests that root applications combined with foliage applications might be more effective than foliage application alone. Observations on other weeds and grasses indicated a more selective action than from foliar spraying. Fall observations also indicated that the difference in response from rates was not great. (Minnesota Agric. Exp. Sta. and Div. Weed Invest., BPI,S & AE, U.S.D.A.) 1/ Paper No. 2761, Sci. Journal Series, Minnesota Agric. Exp. Sta.

Use of maleic hydrazide to antagonize proliferation and rooting of soybean stems induced by 2,4-D. Johnson, B. J. and Buchholtz, K. P. Five row plots, $2\frac{1}{2}$ by 12 feet in size, were established in a field of Monroe soybeans. Plots were treated with 0, 0.25 and 0.50 lbs. per acre of an amine preparation of 2,4-D and with 0, 1, 2 and 4 lbs. per acre of MH as an amine salt. In addition, plots were treated with both materials in all combinations to determine possible antagonistic effects. Treatments were made on June 26 when the soybeans were 10 inches high with three mature trifoliate leaves, using water equivalent to 40 gals. per acre. Four replications were used. On Sept. 4 the 3 center rows from each plot were harvested and wet weights recorded. Average yields of plots treated with 0.25 and 0.50 lbs. of 2,4-D were 4.98 and 4.22 lbs. while plots treated with 1, 2, and 4 lbs. of MH yielded 2.77, 2.51 and 2.33 lbs. Check plots yielded 5.94 lbs. Plants on plots treated with 2,4-D alone showed abundant stem proliferation and development of adventitious roots as well as stem bending, leaf epinasty and formative effects. All concentrations

of MH sharply reduced internode elongation and produced moderate formative effects. None of the plants from plots given combination treatments showed the stem proliferation and root development usually induced by 2,4-D. The short internode development typical of plants treated with MH was maintained and stem bending as well as formative effects were present. Wet weights of soybeans from a typical series were 4.98, 3.07, 2.64 and 2.01 lbs. for plots treated with 0.25 lb. of 2,4-D and with 0, 1, 2 and 4 lbs. of MH. There was only limited evidence of other antagonistic or additive effects from the combination treatments other than the elimination of stem proliferation and root stimulation. (Dept. Agron. U. Wis.)

Preliminary investigations of the response of wild oats (Avena fatua) to Endothal. Kratochvil, D. E., Swanson, C. R., and Helgeson, E. A. Wild oats grown in the greenhouse were treated at the average height of 2 inches with 1.5, 3, or 6 lbs. per acre of Endothal (3, 6 endoxohexahydro-phthalate). Similar trials using rates of 2 to 8 lbs. per acre were applied to drilled wild oats in field tests. Sugar beets infested with a heavy stand of wild oats were treated when the wild oats were heading with rates of ½, 1, 1½, 2, 2½, 3, 4, 6, or 8 lbs. of Endothal per acre.

Results of these trials indicate rates of Endothal in excess of 6 pounds per acre will eradicate 80 percent or more wild oats, stage of growth having little effect on the final result.

Wild oats treated with Endothal show a very rapid response. In 12 to 24 hours the plant appears wilted and the cells seem to lose their turgidity, giving an appearance of being water soaked as if they had been mechanically crushed. Two to four days after treatment, the leaves turn brown and dry up. Roots of wild oats are injured severely. A plant, if not entirely eliminated, will be left stunted with approximately 1-4 roots remaining alive upon which the plant must depend. With this reduction in root system the plant that is not killed will remain stunted the remainder of the season and in most cases fail to produce seed. (Div. Weed Invest., BPISAE, and N. Dak. Agr. Exp. Sta.)

The phytotoxic effects of aqueous extracts of leafy spurge.[1] Le Tourneau, Duane. Aqueous extracts of stems and leaves of dried leafy spurge (Euphorbia esula) contain some material (or materials) which inhibits radicle growth of germinating peas, wheat, and tomatoes and also inhibits the germination of wheat and flax. Seeds which do not germinate in the presence of these extracts regain their ability to germinate if removed from the extracts. Extracts applied to beans and tomatoes growing in the greenhouse have had no effects. Using surface sterilized Mida wheat germinating under aseptic conditions in Petri plates provided with germination blotter paper as a bioassay, it appears that the active fraction of the extract is a dialyzable, non-volatile, heat stable, organic material with basic properties. Preliminary laboratory experiments indicate it is not alkaloidal. The material is soluble in water, methyl alcohol, and acetone but insoluble in benzene. Similar experiments have shown that other plants also contain materials inhibitory to germination and radicle growth of wheat; however, no information is as yet available as to the chemical nature of these materials. Further experiments are in progress to determine the nature of these inhibitory materials, their possible role in nature, and their potential utility. (Div. Plant Path. Agr. Bot. Minn. Agr. Exp. Sta. Supported in part by grants from Graduate School, U. Minn.) [1] Paper No. 2742, Sci. Journal Series, Minn. Agr. Exp. Sta.

Reaction of Barley to 2,4-D when applied at different stages of growth. Olson, P. J. and Friesen, George. A butyl ester of 2,4-D was sprayed on Montcalm barley at 8 ounces acid equivalent per acre, on each of 20 dates starting before emergence

and continuing at approximately 3-day intervals until the crop was well past heading. The results supported those of previous years in delineating two widely separated periods during which the crop was particularly susceptible to injury. The first was represented by early seedling stages when the plants were 3 to 6 inches tall and had 2 to 3 leaves. The second occurred in the boot stage 3 to 7 days in advance of heading. The extent of the damage was similar at both stages. Very low yields were also recorded for the 19th treatment date which was 3 days past heading. Very severe lodging was associated with this treatment. (Div. Plant Science, U. Manitoba)

The Seasonal Development of Johnson Grass Plants. Oyer, Edwin B., Gries, George A., Lee, Oliver C. As a basis for understanding the effectiveness of control measures applied at different times throughout the growing season, a study was made of the seasonal development of the rhizomes, crowns, and tops of Johnson grass. Both seedlings and plants propagated from rhizomes were used. Several misconceptions regarding the vegetative cycle of this plant, growing in the latitude of southern Indiana, have been clarified. Rhizome development by seedlings may occur within a period of six weeds from germination and may precede heading of the plants. Both aerial and subterranean branches are formed from crowns and rhizomes with no relation to node position. When crowns of plants are covered intentionally or during cultivation, rhizomes may develop from axillary buds at any node below the soil surface. Following overwintering, new growth is both apical and from axillary buds. The top-rhizome ratio decreases as the season progresses to a value of approximately 3.0 at the time of maximum top growth. The ratio continues to diminish with further rhizome development. Additional studies are being made to determine the effect of herbicidal treatments on the carbohydrate reserves of rhizomes. (Dep. Bot. & Pl. Path, Agr. Exp. Sta., Purdue Univ.)

Responses of Corn to 2,4-D. Rodgers, Earl G. The response of corn to 2,4-D varies greatly with the stage of growth at time of treatment as well as with other factors. Stalk brittleness in W22 and W22xM14 was serious at 2 days, but most severe 5 to 11 days after treatment at the 6- to 11-leaf stages. Brittleness occurred at or near the basal nodes and was associated with rupture and weakening of the hypodermis and rind by abnormal development of adventitious roots. WF9 and WF9 x Os420 developed little or no brittleness nor abnormal brace roots from 2,4-D treatments at any time. Stage of growth was dominant over rate of growth in development of stalk brittleness from 2,4-D in W22xM14, as determined from a split application of NH_4NO_3. Stalk weakness at harvest time was severe in plants which had shown stalk brittleness after treatment at the 6- to 11-leaf stages. Shank brittleness at harvest was severe in W22xM14 plants treated during rapid shank elongation. Viability was reduced only in seed produced by W22 and W22xM14 plants treated at the pretasseling, 16- to 18-leaf stages. The vigor of the subsequent seedlings in these strains was reduced by treatment at these late stages, but reductions in WF9 and WF9xOs420 resulted from earlier sprays. Yield reductions were most marked in W22 and W22xM14 plants treated at the 16- to 18-leaf stages while smaller but noticeable reductions followed treatment of WF9 and WF9xOs420 plants at the 6- to 8-leaf stages. (Univ. Florida)

The effects of Chloro IPC on various crops and its residual properties in various soils. Stevens, L. F., and Carlson, R. F. Soils of light, heavy, and organic types were treated with Chloro IPC at the rate of 2, 6, 12, and 24 pounds per acre, and leached each week with 1, 1½, and 2 inches of surface water. Toxicity, determined by the inhibition of germinating oats, persisted in the light and heavy soils for 30, 60, 76, and 104 days, and 44, 76, 90, and 148 days in the organic soil. Leaching did not effect this loss of toxicity. In another experiment the

same soil types were adjusted to pH 3, 7, and 8.5 and the compound applied at the rate of 2 and 24 pounds. At the lower rate the acid soil lost its toxicity before the alkaline soil, while at the higher rate the opposite relationship occurred. The high rate in heavy alkaline soil lasted only 72 days. In a third experiment temperatures of 35 and 55°F. prolonged the time of persistance, with the 2 pound dosage lasting up to 6 weeks in the organic soil and more than 12 weeks for the light and heavy soil. Soil stored at 75°F. was not toxic after 2 to 4 weeks. A field comparison of IPC with Chloro IPC showed that IPC at the rate of 2, 6, and 12 pounds disappeared within 6 weeks independent of the dosage, while Chloro IPC was toxic from 8 to more than 12 weeks depending on the rate. Pre-planting, residual pre-emergence, and post-emergence treatments were made in the field to corn, sorghum, oats, rye, wheat, soybeans, Red clover, Ladino clover, and alfalfa at rates of 1, 3, 6, and 12 pounds. Post-emergence applications burned the foliage of all crops. Pre-planting and pre-emergence treatments were fairly satisfactory in the 1 to 3 pound range on sorghum and legumes, except Red Clover. Pre-emergence treatments up to 6 pounds proved very successful on corn. (Dept. Hort., Mich. State College)